

USER'S GUIDE



Vaisala DRYCAP[®] Dewpoint Transmitters DMT345 and DMT346



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Vaisala Oyj
P.O. Box 26
FIN-00421 Helsinki
Finland

Phone (int.): +358 9 8949 1
Fax: +358 9 8949 2227

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CHAPTER 1

GENERAL INFORMATION

This chapter provides general notes for the manual and the product.

About This Manual

This manual provides information for installing, operating, and maintaining Vaisala DRYCAP[®] Dewpoint Transmitters DMT345 and DMT346.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the product.
- Chapter 2, Product Overview, introduces the features and advantages of Vaisala DRYCAP[®] Dewpoint Transmitter DMT345 and DMT346.
- Chapter 3, Installation, provides you with information that is intended to help you install this product.
- Chapter 4, Operation, contains information that is needed to operate this product.
- Chapter 5, Calibration and Adjustment, provides you with instructions on how to calibrate and adjust Vaisala DRYCAP[®] Dewpoint Transmitters DMT345 and DMT346.

- Chapter 6, Maintenance, provides information that is needed in basic maintenance of the product. Possible error states and situations, their probable causes and remedies are described in this chapter. This chapter also contains contact information for Vaisala Technical Support and Vaisala Service Centers.
- Chapter 7, Technical Data, provides the technical data of the product.
- Appendix A, Example Installation of DMT346, This Appendix illustrates an example installation of DMT346 transmitter into a process.
- Appendix B, Calculation Formulas, This Appendix contains the formulas used for the calculated output quantities.

Version Information

Table 1 Manual Revisions

Manual Code	Description
M210726EN-A	First version of the manual, May 2006

Related Manuals

Table 2 Related Manuals

Manual Code	Manual Name
M010091EN-E	Vaisala DRYCAP® Hand-Held Dewpoint Meter DM70 User's Guide, March 2006
M210185en-B	Humidity Calibrator HMK15 User's Guide

Safety

General Safety Considerations

Throughout the manual, important safety considerations are highlighted as follows:

WARNING

Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION

Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE

Note highlights important information on using the product.

Product Related Safety Precautions

The DMT345/46 Dewpoint and Temperature Transmitter delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:

WARNING

Ground the product, and verify outdoor installation grounding periodically to minimize shock hazard.

CAUTION

Do not modify the unit. Improper modification can damage the product or lead to malfunction.

ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. However, it is possible to damage the product by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

- Handle ESD sensitive components on a properly grounded and protected ESD workbench. When this is not possible, ground yourself to the equipment chassis before touching the boards. Ground yourself with a wrist strap and a resistive connection cord. When neither of the above is possible, touch a conductive part of the equipment chassis with your other hand before touching the boards.
- Always hold the boards by the edges and avoid touching the component contacts.

Recycling



Recycle all applicable material.



Dispose of batteries and the unit according to statutory regulations. Do not dispose of with regular household refuse.

Feedback

Vaisala Customer Documentation Team welcomes your comments and suggestions on the quality and usefulness of this publication. If you find errors or have other suggestions for improvement, please indicate the chapter, section, and page number. You can send comments to us by e-mail: manuals@vaisala.com

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Warranty

Vaisala hereby represents and warrants all Products manufactured by Vaisala and sold hereunder to be free from defects in workmanship or material during a period of twelve (12) months from the date of delivery save for products for which a special warranty is given. If any Product proves however to be defective in workmanship or material within the period herein provided Vaisala undertakes to the exclusion of any other remedy to repair or at its own option replace the defective Product or part thereof free of charge and otherwise on the same conditions as for the original Product or part without extension to original warranty time. Defective parts replaced in accordance with this clause shall be placed at the disposal of Vaisala.

Vaisala also warrants the quality of all repair and service works performed by its employees to products sold by it. In case the repair or service works should appear inadequate or faulty and should this cause malfunction or nonfunction of the product to which the service was performed Vaisala shall at its free option either repair or have repaired or replace the product in question. The working hours used by employees of Vaisala for such repair or replacement shall be free of charge to the client. This service warranty shall be valid for a period of six (6) months from the date the service measures were completed.

This warranty is however subject to following conditions:

- a) A substantiated written claim as to any alleged defects shall have been received by Vaisala within thirty (30) days after the defect or fault became known or occurred, and
- b) The allegedly defective Product or part shall, should Vaisala so require, be sent to the works of Vaisala or to such other place as Vaisala may indicate in writing, freight and insurance prepaid and properly packed and labelled, unless Vaisala agrees to inspect and repair the Product or replace it on site.

This warranty does not however apply when the defect has been caused through

- a) normal wear and tear or accident;
- b) misuse or other unsuitable or unauthorized use of the Product or negligence or error in storing, maintaining or in handling the Product or any equipment thereof;
- c) wrong installation or assembly or failure to service the Product or otherwise follow Vaisala's service instructions including any repairs or installation or assembly or service made by unauthorized personnel not approved by Vaisala or replacements with parts not manufactured or supplied by Vaisala;
- d) modifications or changes of the Product as well as any adding to it without Vaisala's prior authorization;
- e) other factors depending on the Customer or a third party.

Notwithstanding the aforesaid Vaisala's liability under this clause shall not apply to any defects arising out of materials, designs or instructions provided by the Customer.

This warranty is expressly in lieu of and excludes all other conditions, warranties and liabilities, express or implied, whether under law, statute or otherwise, including without limitation any implied warranties of merchantability or fitness for a particular purpose and all other obligations and liabilities of Vaisala or its representatives with respect to any defect or deficiency applicable to or resulting directly or indirectly from the Products supplied hereunder, which obligations and liabilities are hereby expressly cancelled and waived. Vaisala's liability shall under no circumstances exceed the invoice price of any Product for which a warranty claim is made, nor shall Vaisala in any circumstances be liable for lost profits or other consequential loss whether direct or indirect or for special damages.

CHAPTER 2

PRODUCT OVERVIEW

This chapter introduces the features and advantages of Vaisala DRYCAP[®] Dewpoint Transmitter DMT345 and DMT346.

Introduction to Vaisala DRYCAP[®] Dewpoint Transmitters DMT345 and DMT346

Vaisala DRYCAP[®] Dewpoint Transmitters DMT345 and DMT346 incorporate the advanced Vaisala DRYCAP[®] technology, which enables reliable and accurate dewpoint measurement. Both transmitters also feature the AutoCal function which provides excellent long term stability of the measurement.

Vaisala DRYCAP[®] Dewpoint Transmitter DMT345 is designed for measurement of relative humidity in temperatures up to 180 °C. The transmitter outputs dewpoint/frostpoint (Td/f), mixing ratio (x), volume concentration (ppm), relative humidity (RH) and temperature (T).

Vaisala DRYCAP[®] Dewpoint Transmitter DMT346 is a high-performance instrument for measurement of dewpoint and mixing ratio in temperatures up to 350 °C.

DMT346 also outputs sensor saturation rate (SSR) and temperature ($T_S = T_{\text{Sensor}}$) of the cooled Vaisala DRYCAP[®] sensor. Because the sensor is cooled, these values do not represent true process conditions, hence they cannot be used for process control. Nevertheless, they provide a valuable aid for calibration and for checking the cooling effect.

For quantities measured by DMT345, see Table 3 below. For the optional calculated quantities measured by DMT345, see Table 4 below.

For quantities measured and calculated by DMT36, see Table 5 below.

Table 3 Output Quantities and Their Abbreviations for Vaisala DRYCAP® Dewpoint Transmitter DMT345

Quantity	Abbreviation	Metric Unit	Non Metric Unit
Dewpoint/frost point temperature ($T_{d/f}$)	TDF	°C	°F
Mixing ratio (x)	X	g/kg	gr/lb
Relative humidity RH	RH	%RH	%RH
Temperature T	T	°C	°F

Table 4 Optional Output Quantities and Their Abbreviations for Vaisala DRYCAP® Dewpoint Transmitter DMT345

Quantity	Abbreviation	Metric Unit	Non Metric Unit
Parts per million	H2O	ppm _v / ppm _w	ppm _v / ppm _w
Absolute humidity (a)	A	g/m ³	gr/ft ³
Absolute humidity in standard pressure and temperature (NTP)	ANTP	g/m ³	gr/ft ³
Water vapor pressure (P_w)	PW	hPa	lb/in ²
Water vapor saturation pressure (P_{ws})	PWS	hPa	lb/in ²
Enthalpy (h)	H	kJ/kg	Btu/lb
Difference of T and $T_{d/f}$ (ΔT)	DT	°C	°F

1) Use these parameters only if you need dewpoint over water below 0 °C/32 °F and not over ice (industry standard)

Table 5 Output Quantities and Their Abbreviations for Vaisala DRYCAP® Dewpoint Transmitter DMT346

Quantity	Abbreviation	Metric Unit	Non Metric Unit
Dewpoint temperature ($T_{d/f}$)	TDF	°C	°F
Mixing ratio (x)	X	g/kg	gr/lb
Sensor saturation rate	SSR	%	-
Sensor temperature	TS	°C	°F

Basic Features and Options

DMT345/346 has the following basic features and options:

- Dewpoint measurement with AutoCal and sensor purge features.
- Sensor warming in high humidities.
- Two analog outputs and a serial interface, optional third analog output.
- Installation accessories
 - DMT345: mounting flange,
 - DMT346: cooling set for high temperature applications.
- User friendly multilingual display option.
- Different sensor protection options and probe cable lengths 2 m, 5 m or 10 m.
- Optional modules: galvanic isolation for outputs, AC mains power supply, RS-485 serial line, relay module.

Operating Principle

The DMT345/346 transmitter incorporates the Vaisala DRYCAP[®] sensor, which uses an operating principle based on changes in capacitance as its thin polymer film absorbs water molecules together with a combined temperature measurement with a PT100 resistive temperature sensor.

The DMT345/346 transmitter measures water vapor directly and gives thus accurate results of moisture in the process. In DMT346 the sensor is cooled down with a cooling set which makes it possible to use a polymer sensor in very high temperatures, for example +100 ... +350 °C. With this technique, no complicated sampling systems are needed. The cooling set is thermally isolated from the process itself. The temperature of the sensor is cooled down which increases the sensor saturation rate.

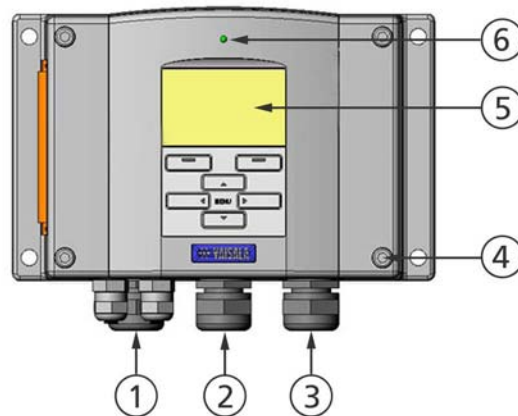
Sensor saturation rate and temperature are then measured, and the transmitter calculates the dewpoint and the mixing ratio on the basis of these readings.

Note that for DMT346, SSR and temperature values don't represent the process itself as they are measured after cooling. Dewpoint and mixing ratio, however, are independent of temperature and remain unchanged.

The dewpoint measurement range is -25 ... +100 °C

Parts Description

Transmitter Body

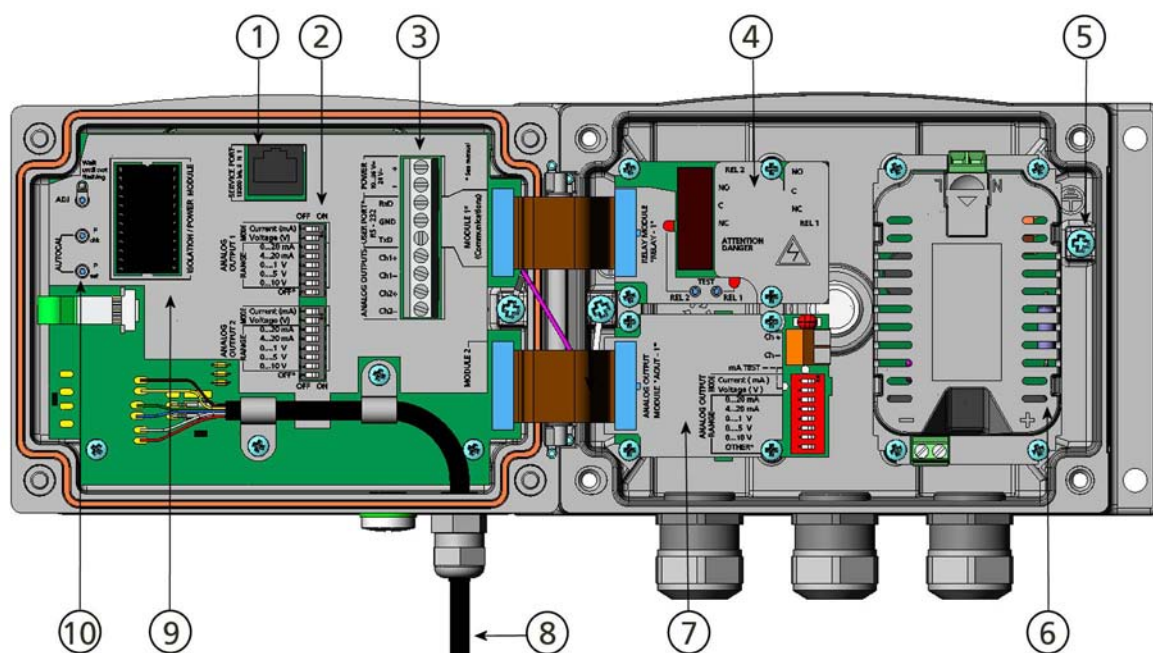


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Figure 1 Transmitter Body

The numbers refer to figure 1 above:

- 1 = Signal + powering cable gland
- 2 = Cable gland for optional module
- 3 = Cable gland for optional module
- 4 = Cover screw (4 pcs)
- 5 = Display with keypad (optional)
- 6 = Cover LED



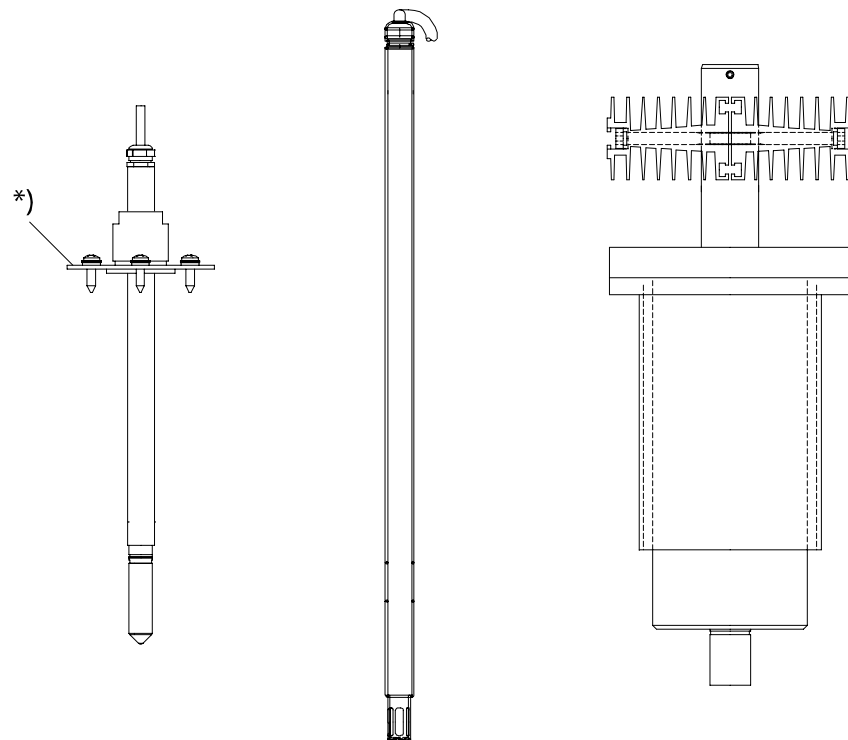
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Figure 2 Inside of Open Transmitter

Numbers refer to Figure 2 above:

- 1 = Service port (RS-232)
- 2 = Dip switches for analog output settings
- 3 = Power supply and signal wiring screw terminals
- 4 = Relay or RS-485 module (optional)
- 5 = Grounding connector
- 6 = Power supply module (optional)
- 7 = Analog output relay module (optional)
- 8 = Dewpoint probe
- 9 = Output isolation module (optional)
- 10 = Adjustment button and Manual AutoCal buttons with indicator led and pressure set buttons.

Probes and Cooling Set



0604-007

Figure 3 Probes, Cooling Set

Figure 3 above shows from left to right: DMT345 probe, DMT346 probe and the cooling set. The probes are available with the following cable lengths: 2 m, 5 m and 10 m.

*) = Optional mounting flange for DMT345 probe

CHAPTER 3

INSTALLATION

This chapter provides you with information that is intended to help you install this product.

Selecting Location

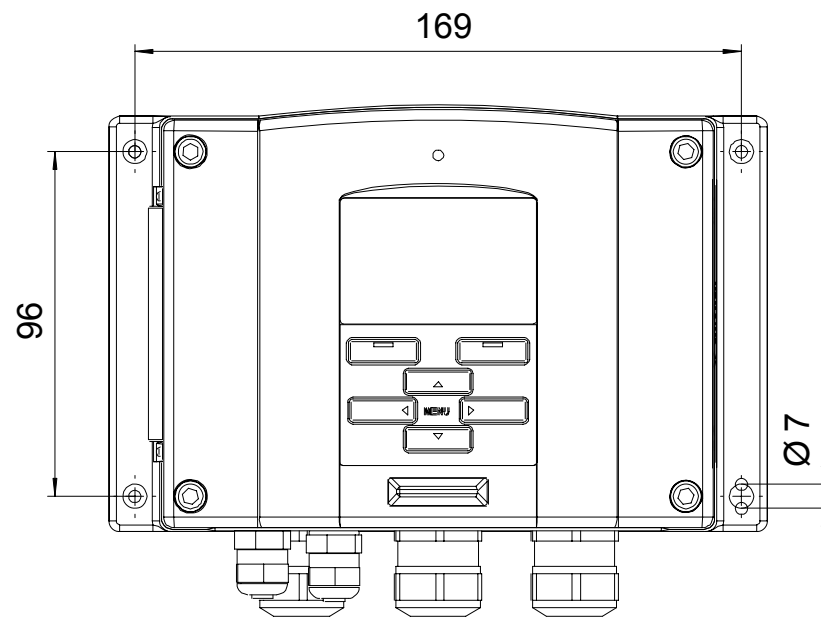
Finding a suitable site for the dewpoint measurement probe is important for getting representative process or environmental measurements. The location of the probe should provide a good representation of the area of interest. Also select a location that is as clean as possible. Air should circulate freely around the sensor.

Mounting the Housing

The housing can be mounted either without the mounting plate or with optional mounting plates.

Standard Mounting without Mounting Plate

Mount the housing without the mounting plate by fastening the transmitter to the wall with 4 screws, for example M6 (not provided).

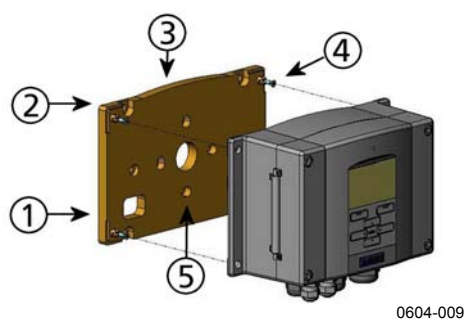


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Figure 4 Standard Mounting

Wall Mounting with Wall Mounting Kit

When mounting with wall mounting kit the mounting plate (Vaisala order code: 214829) can be installed directly on wall or onto a standard wall box (also US junction box). When wiring through back wall, remove the plastic plug from the wiring hole in the transmitter before mounting.

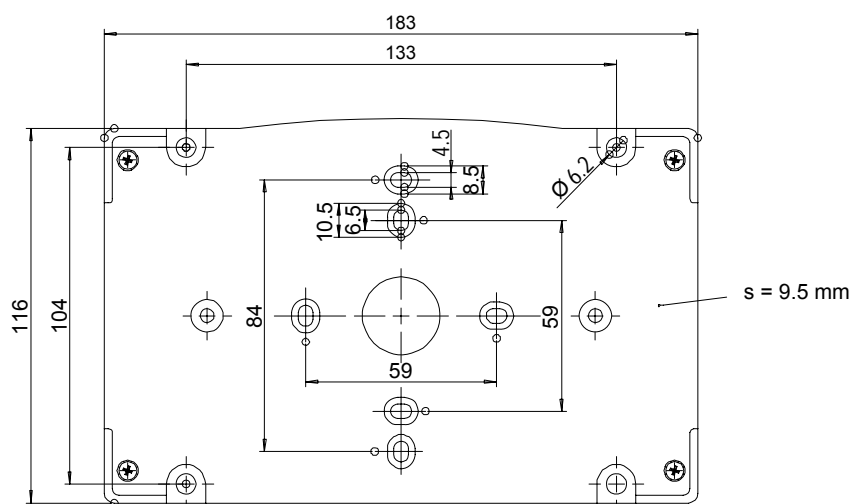


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Figure 5 Mounting with Wall Mounting Kit

The following numbers refer to Figure 5 above:

- 1 = Plastic mounting plate
- 2 = Mount the plate to wall with 4 screws M6 (not provided)
- 3 = The arched side up
- 4 = Fasten the transmitter to the mounting plate with 4 fixing screws M3 (provided)
- 5 = Holes for wall/junction box mounting



0604-010

Figure 6 Dimensions of Plastic Mounting Plate

Metal mounting plate is included in rain shield with installation kit and installation kit for pole or pipeline.

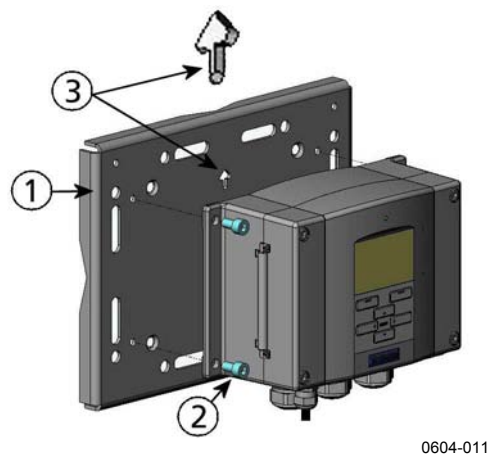
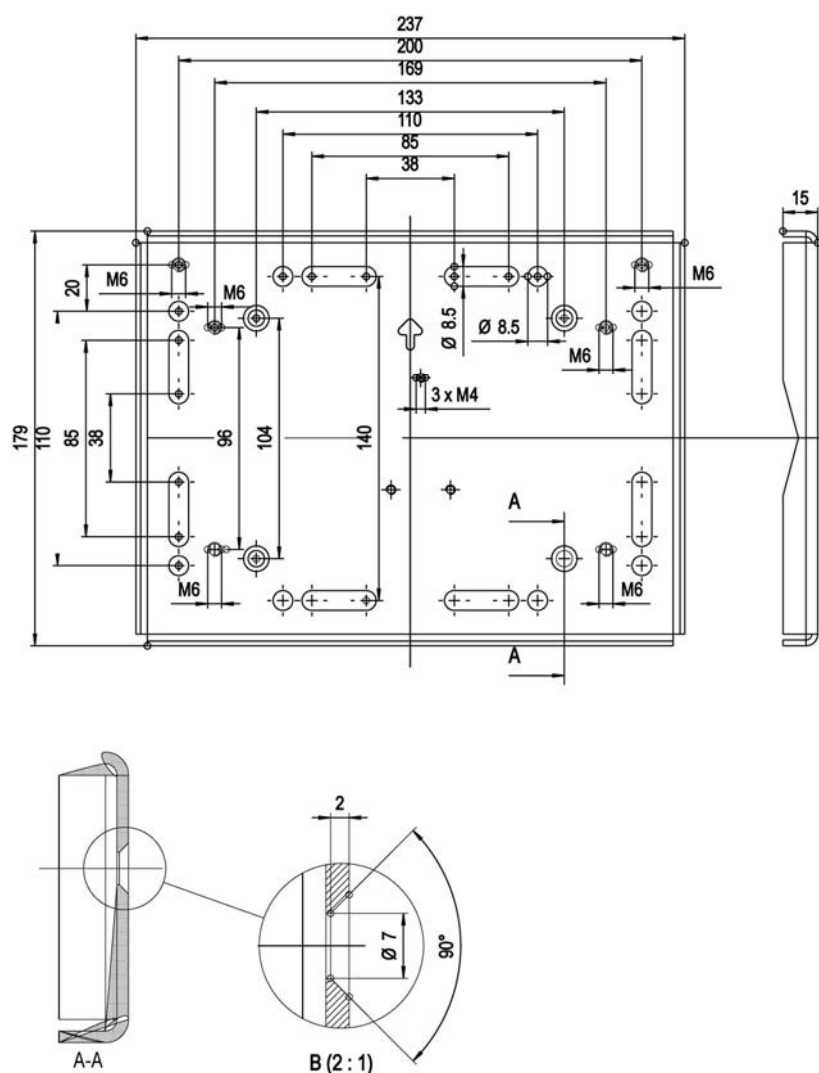


Figure 7 Mounting with Metal Wall Mounting Plate

Numbers refer to Figure 7 above:

- 1 = Mount the plate to wall with 4 screws M8 (not provided)
- 2 = Fasten the transmitter to the mounting plate with 4 fixing screws M6 (provided)
- 3 = Note the position of the arrow when mounting. This side must be up when mounting.



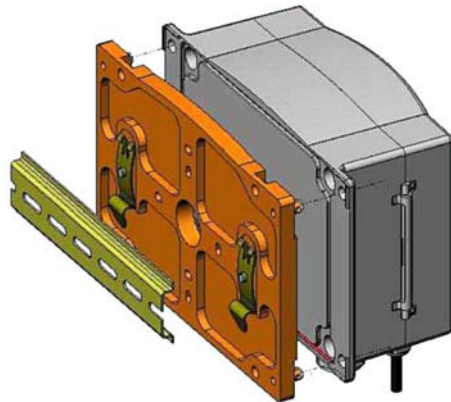
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Figure 8 Dimensions of Metal Mounting Plate in mm

Mounting with DIN Rail Installation Kit

DIN rail installation kit includes a wall mounting kit, 2 clip-fasteners and 2 screws M4 × 10 DIN 7985 (Vaisala order code: 215094).

1. Attach two spring holders to the plastic mounting plate by using the screws provided in the installation kit.
2. Fasten the transmitter to the plastic mounting plate with 4 screws provided for that purpose.
3. Press the transmitter onto the DIN rail so that the clip-fasteners snap into the rail.

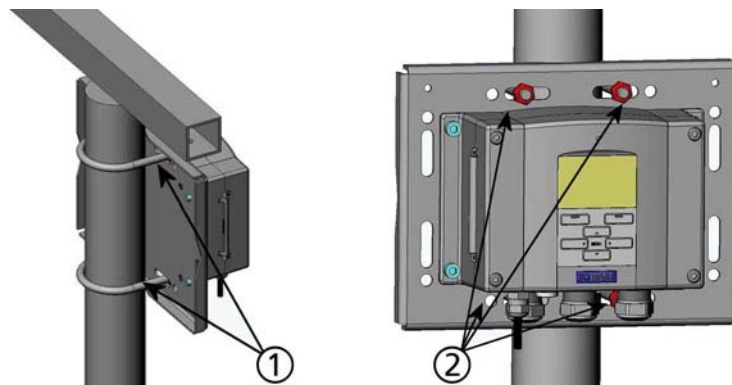


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Figure 9 **Mounting with DIN Rail Installation Kit**

Pole Installation with Installation Kit for Pole or Pipeline

Installation kit for pole or pipeline (Vaisala order code: 215108) includes the metal mounting plate and 4 mounting nuts for pole mounting. When mounting, the arrow in the metal mounting plate must point upwards, see Figure 7 on page 24.

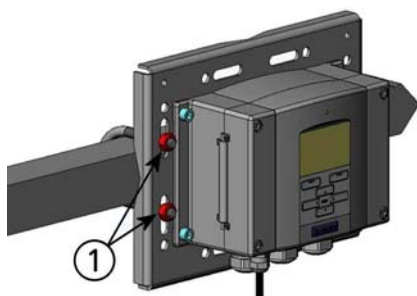


0604-014

Figure 10 **Vertical Pole Installation**

Numbers refer to Figure 10 above:

- 1 = Fixing brackets (2 pcs) M8 (provided) for 30 ... 102 mm poles.
- 2 = Mounting nuts M8 (4 pcs)



0604-015

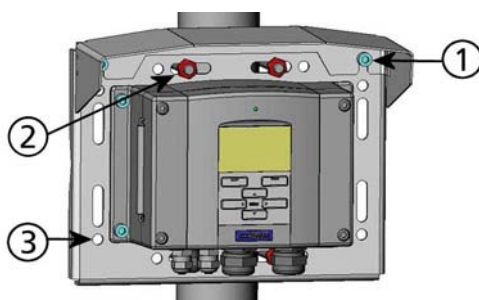
Figure 11 Horizontal Pole Installation

Number refers to Figure 11 above:

1 = Mounting nuts M8 (4 pcs)

Mounting Rain Shield with Installation Kit

Vaisala order code for the rain shield: 215109.



0604-016

Figure 12 Mounting the Rain Shield with Installation Kit

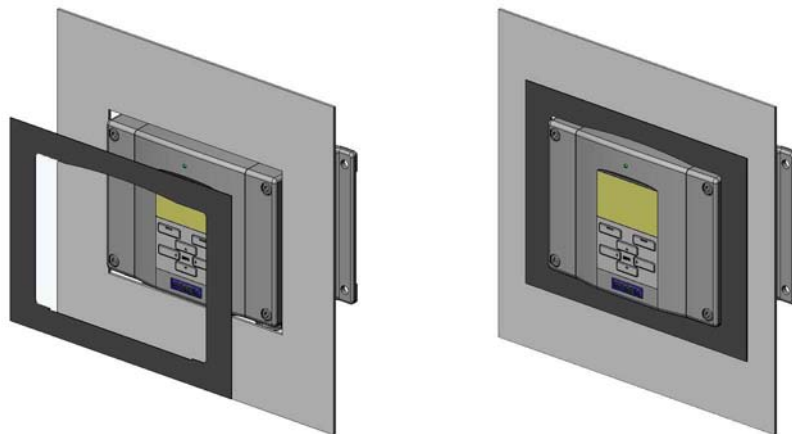
Numbers refer to Figure 12 above:

- 1 = Fasten the rain shield with installation kit to the metal mounting plate with 2 (M6) mounting screws (provided).
- 2 = Fasten the mounting plate with rain shield with installation kit to the wall or to the pole (see pole installation).
- 3 = Fasten the transmitter to the mounting plate with 4 fixing screws (provided).

Panel Mounting Frame

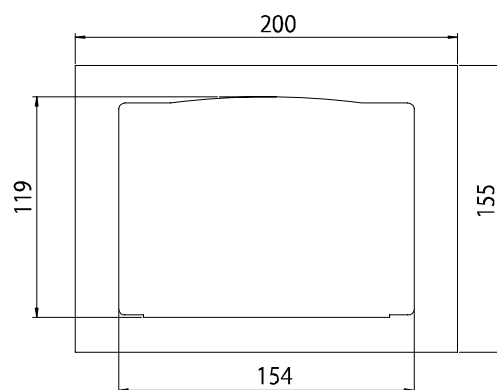
A panel mounting frame with adhesive tape is available as an option (Vaisala order code: 216038). After the DMT346 has been installed through the panel, a frame can be used to finish off the sawed surface of the panel.

1. Mount the transmitter to the panel.
2. The frame is attached to the panel with an adhesive tape attached to the frame. Remove the paper protecting the tape before attaching.
3. Attach the frame to the panel around the DMT346 to finish off the panel mounting as illustrated, see Figure 13 below.



0503-024

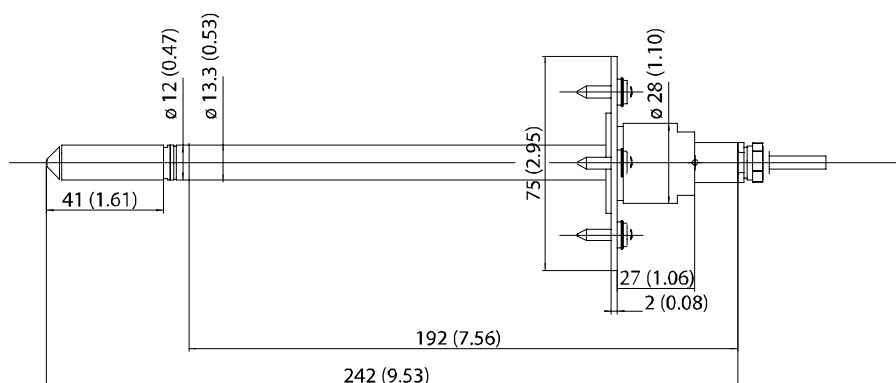
Figure 13 Panel Mounting with Frame



0604-017

Figure 14 Panel Mounting Dimensions

DMT345 Probe Mounting



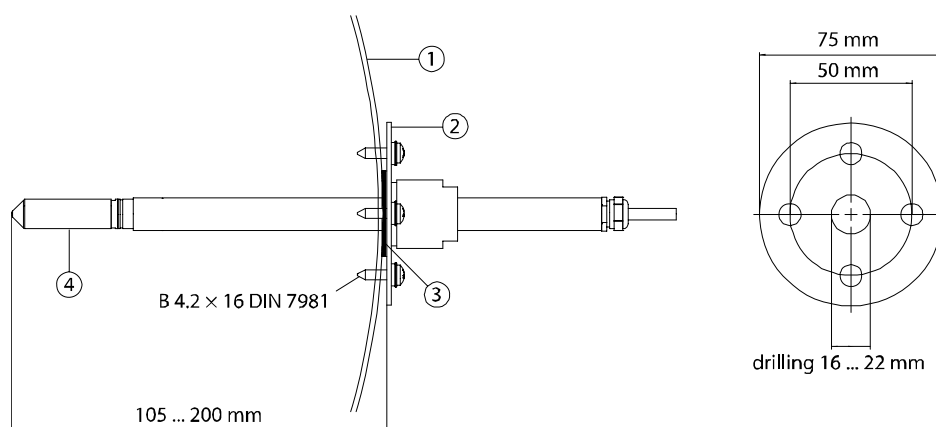
0604-018

Figure 15 DMT345 Probe Dimensions in mm (inches)

Installation with Flange

The DMT345 is a small size ($d = 12$ mm) general purpose probe suitable for installation through process or duct walls with the flange installation kit available from Vaisala.

The duct installation kit includes a flange, a sealing ring and screws for attaching the flange to the process or duct wall (Vaisala order code: 210696).



0604-019

Figure 16 Flange Installation Kit

The following numbers refer to Figure 16 on page 29:

- 1 = Process or duct wall
- 2 = Flange
- 3 = Sealing ring
- 4 = Probe

NOTE

When the temperature difference between the process or duct and the surroundings is large, the probe must be installed as deep in the process or duct as possible. This prevents errors caused by heat conduction in the probe cable.

DMT346 Probe and Cooling Set Mounting

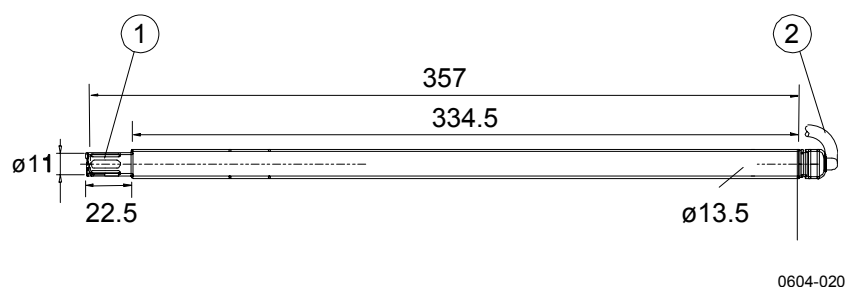


Figure 17 DMT346 Probe Dimensions in mm

The following numbers refer to Figure 17 above:

- 1 = Stainless steel grid
- 2 = Cable (length 2 m, 5 m or 10 m)

Description of the Cooling Set

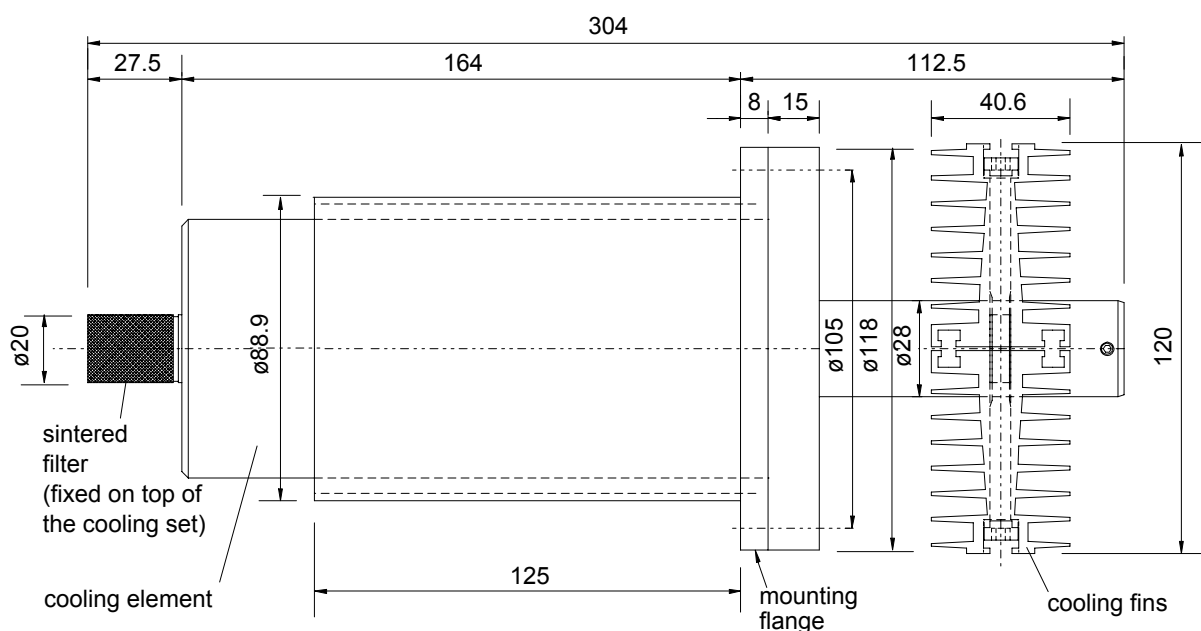


Figure 18 Cooling Set Dimensions in mm

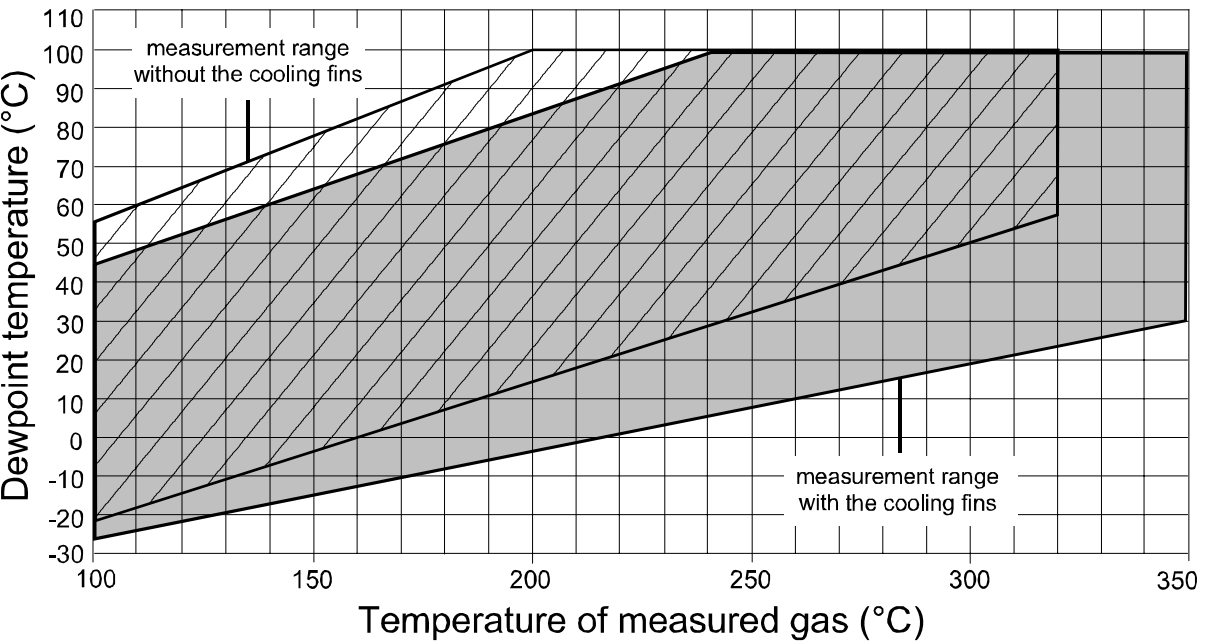
The cooling set consists of a cooling element and removable cooling fins. The cooling fins are meant to be installed in applications where the process temperature and dewpoint are continuously in the range indicated in Figure 19 on page 32 (Measurement Ranges for Using and Not Using the Cooling Fins). However, if there is a possibility that the dewpoint is above this range, the measurements have to be taken without the cooling fins in order to avoid condensation. The flow rate and ambient temperature have an effect on the cooling rate. In Figure 19, it is assumed that ambient temperature is +25 °C. When ambient temperature is raised by +10 °C, the measurement ranges with and without cooling fins rise approximately +6 °C. Correspondingly, every -10 °C change in ambient temperature changes the ranges by approximately -6 °C. It is recommended that after installing the transmitter without the cooling fins, the transmitter is allowed to stabilize and then the SSR reading is checked either from the local display or with a terminal connected to an RS line. If the SSR reading is below 20 %, it is recommended that the cooling fins are installed.

NOTE

Make sure that the upper limit of the dewpoint measurement range is not exceeded in low temperatures as this would lead to condensation.

NOTE

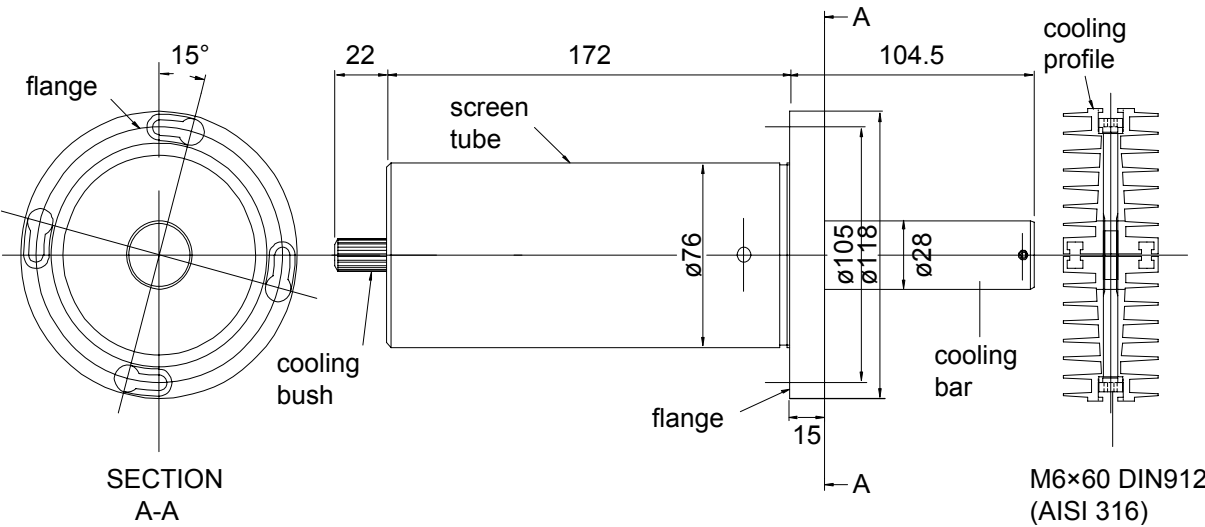
When measuring temperature dependent quantities make sure that the temperature at the measurement point is equal to that of the process, otherwise the moisture reading may be incorrect.



0604-022

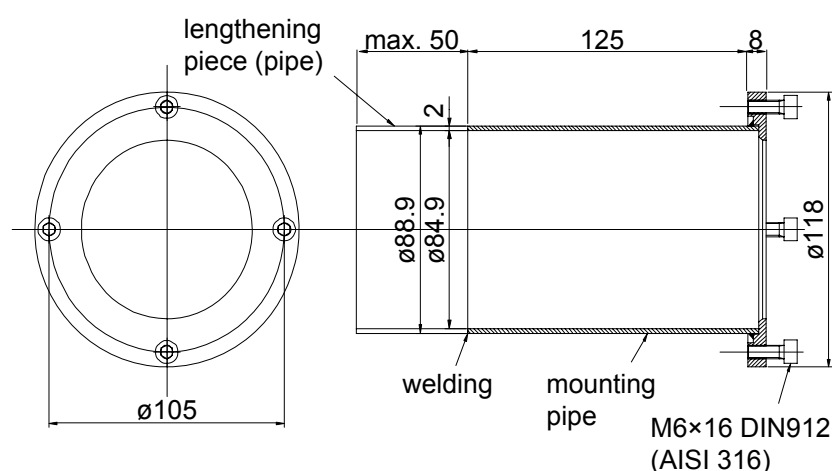
Figure 19 Measurement Ranges for Using and Not Using the Cooling Fins

Parts of the Cooling Set



0604-023

Figure 20 Parts of the Cooling Set (Dimensions in mm)



0605-023

Figure 21 Mounting Flange Dimensions in mm

General Probe and Cooling Set Mounting Instructions

Follow these general mounting instructions to make the installation. Note the additional instructions in the following sections regarding specific situations (mounting with process shut down, mounting with process running, removing the transmitter for maintenance).

Appendix A, Example Installation of DMT346 on page 135 provides photographs of installing DMT346 transmitter through a process wall.

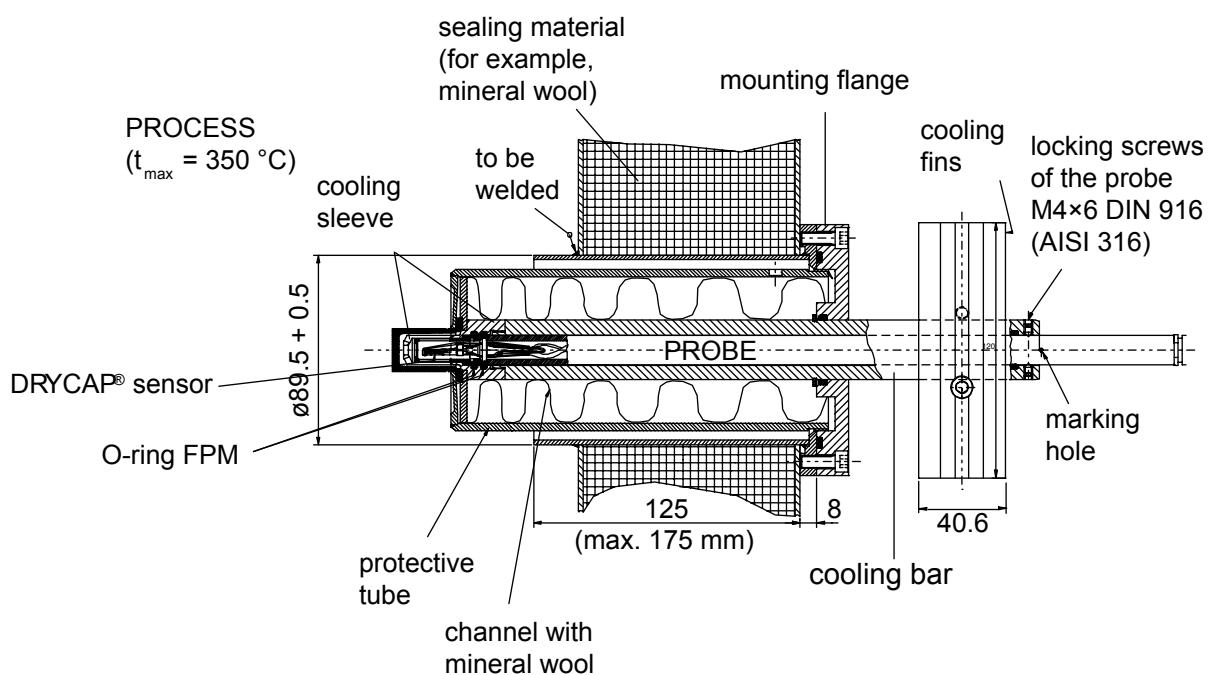
The probe should be installed horizontally whenever possible in order to ensure the best possible performance of the cooling set. Install the probe according to the following instructions (see also Figure 22 on page 34):

1. Make a round $89.5 + 0.5$ mm hole on the process wall.
2. Weld the tube of the mounting flange tightly on the inner metal plate of the process wall. If the process wall is more than 125 mm thick, a lengthening piece (max. 50 mm) can be welded on the mounting tube (for walls thicker than 175 mm, see Figure 23 on page 35).
3. The cooling set is mounted in a vertical position. Tighten the screws properly in order to ensure a thermal contact.
4. Unscrew the locking screws on the cooling bar so that you can push the sensor head into the bar.

NOTE

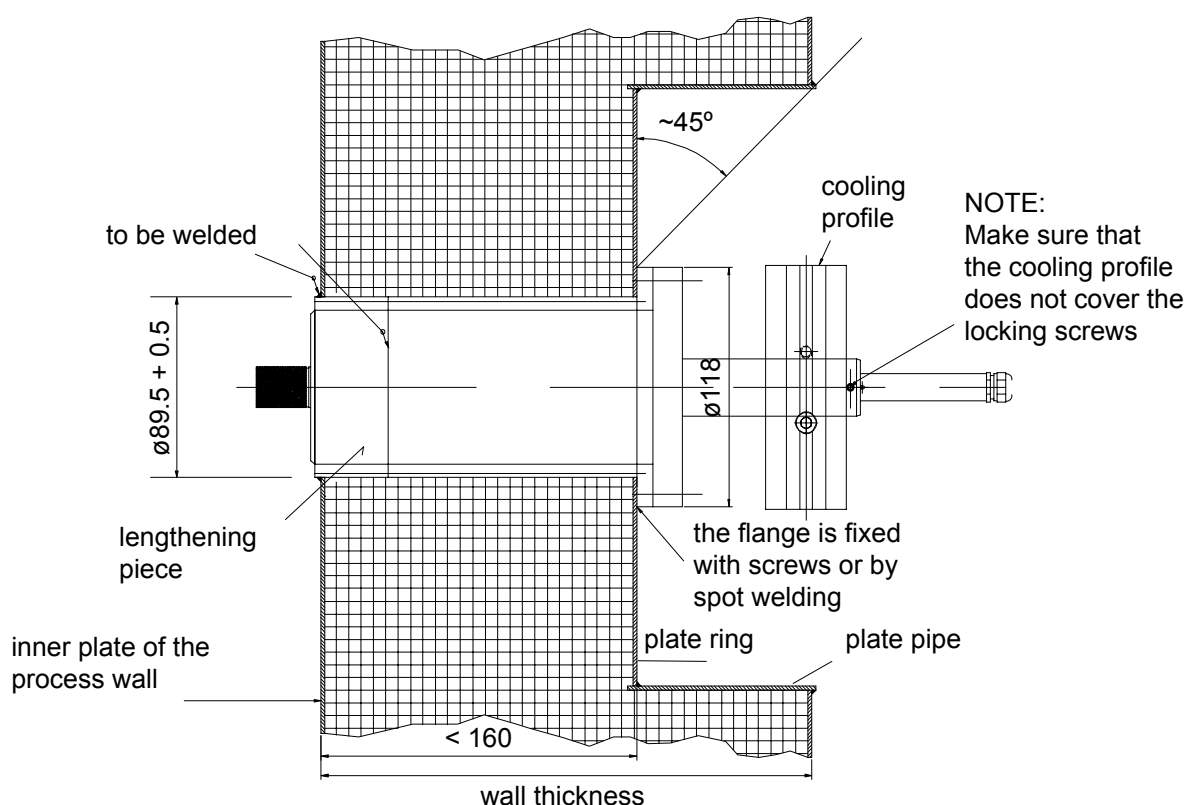
Push the sensor head deep enough: make sure that the marking hole meets the end of the bar.

5. Lock the sensor head in place by tightening the locking screws on the bar.



0604-024

Figure 22 Installing Probe Through Process Wall



0604-025

Figure 23 Installing Probe Through Thick Walls

Probe and Cooling Set Mounting with Process Shut Down

- Complete the entire mounting process as instructed on page 33.

Probe and Cooling Set Mounting with Process Running

- First mount the cooling element (and fins) to warm it up; tightly plug the hole for the probe in the cooling element for the duration of the warmup period.
- After a few hours, complete the installation by installing the probe.

This procedure should lessen the amount of condensation that builds up in the hole.

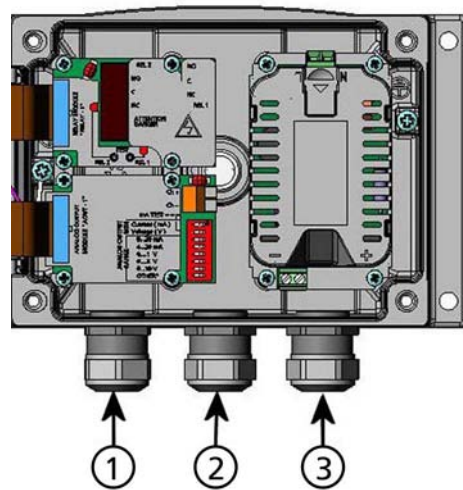
Removing Transmitter for Maintenance

- If you remove the transmitter from the process to send it to service etc., leaving the cooling set in its place, make sure you plug tightly the hole for the probe in the cooling element. This will lessen the amount of condensation that builds up in the hole.

Wiring

Cable Bushings

A single electrical cable with a screen and three to ten wires is recommended for power and analog/serial connections. The cable diameter should be 8 ... 11 mm. The number of cable bushings depends on the transmitter options. See the following recommendations for the cable bushings:



0605-026

Figure 24 Cable Bushings

Numbers refer to Figure 24 above:

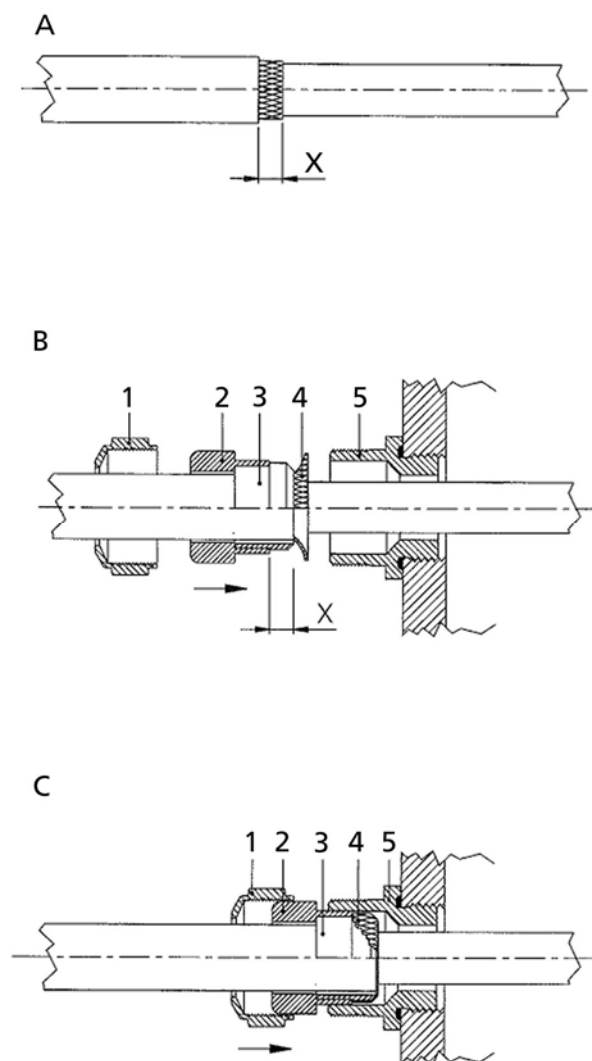
- 1 = Cable for signal/powering Ø8 ... 11 mm
- 2 = Cable for optional module Ø8 ... 11 mm
- 3 = Cable for optional power module Ø8 ... 11 mm

NOTE

When there is high electric noise level (for example near powerful electric motor) in the operating environment it is recommended to use shielded cable or take care that the signal cables are separated from other cables.

Cable Grounding

Ground the screen of the electrical cable properly to achieve the best possible EMC performance.



0605-027

Figure 25 **Grounding the Screen of Electrical Cable**

1. Cut back outer sheath to desired length.
2. Cut back screen braiding or screen foil to dimension X (see Figure 25 A above).
3. Push the domed cap nut (item 1 in Figure 25) and the seal insert with contact socket of the gland (items 2 & 3) onto the cable as shown in the diagram

4. Bend over the screen braiding or screen foil by about 90° (item 4).
5. Push the seal insert with the contact socket of the gland (items 2 & 3) up to the screen braiding or screen foil.
6. Mount lower part (item 5) on the housing
7. Push the seal with the contact socket of the gland and (item 2 & 3) flush into the lower part (item 5).
8. Screw the domed cap nut (item 1) onto the lower part (item 5).

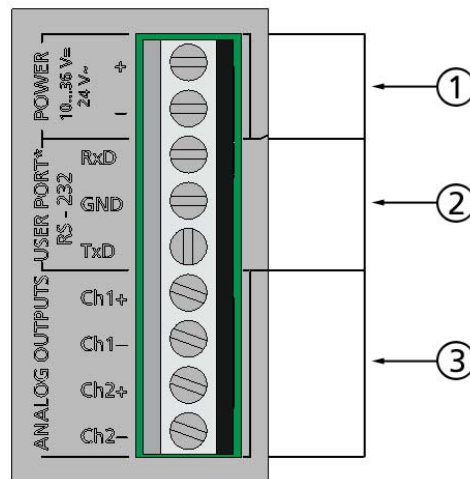
Transmitter Housing Grounding

In case you need to ground the transmitter housing, the grounding connector is found inside the housing (see Figure 1 on page 18) Note anyhow that the probe head is connected to the same potential as the housing. Make sure that different groundings are made to the same potential. Otherwise harmful ground currents may be generated.

If it is needed to have galvanic isolation of the power supply line from the output signals, DMT346 can be ordered with optional output isolation module. This module prevents harmful grounding loops.

Signal and Power Supply Wiring

When connecting transmitter with 8-pin connector, see section 8-Pin Connector on page 52.



0605-028

Figure 26 Screw Terminal Block on the Motherboard

Numbers refer to Figure 26 above:

- 1 = Supply terminals **POWER 10 ... 35 VDC = 24 V~**
- 2 = User port (RS-232 terminals)
- 3 = Analog signal terminals

WARNING

Make sure that you connect only de-energized wires.

1. Open the transmitter cover by taking out the four cover screws.
2. Insert the power supply wires and signal wires through the cable bushing in the bottom of the transmitter; see the grounding instructions in the previous sections.
3. Connect the analog output cables to terminals: **Ch1 +, Ch1-, Ch2+, Ch2-**. Connect the RS-232 user port cables to terminals RxD, GND and TxD, more about the RS-232 connection in Serial Line Communication on page 60.
4. When wiring the RS-485 module or relay module, see Installation and Wiring of RS-422/485 Interface on page 48 and Installation and Wiring of Alarm Relays on page 46.
5. Connect the power supply wires to the connectors:
POWER 10 ... 35 V = 24 V~(+) and **(-)** terminals. (If using AC voltage, **always** connect phase (~) to power supply **(+)** and **0** to power supply **(-)**). When wiring the power supply module, see section Power Supply Module on page 41.
6. Turn on the power. The indicator led on the cover lit continuously during normal operation.
7. Close the cover and replace the cover screws. The transmitter is ready for use.

Connections to 24 VAC Power Supply

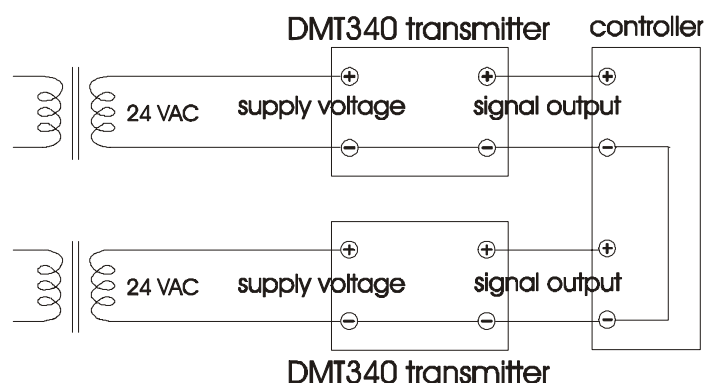
Separate floating supply for each transmitter is recommended (see upper part of Figure 27 on page 41). If you have to connect several transmitters or other instruments to one AC supply, the phase (~) must always be connected to (+) connector of each transmitter (see lower part of Figure 27).

CAUTION

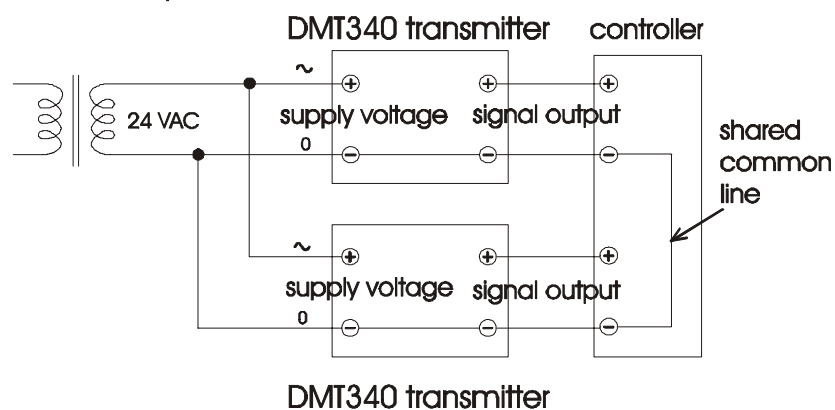
24 VAC POWER SUPPLY USE

To prevent fire and/or damage, if either 24 VAC wire is **grounded** or **connected to a "-", "0", or "GND" terminal** of any other device, you must **connect the same wire on the "-" terminal** also on this instrument.

No common loop - RECOMMENDED!



Common loop formed - NOT recommended!



0605-029

Figure 27 Connections to 24 VAC Power Supply

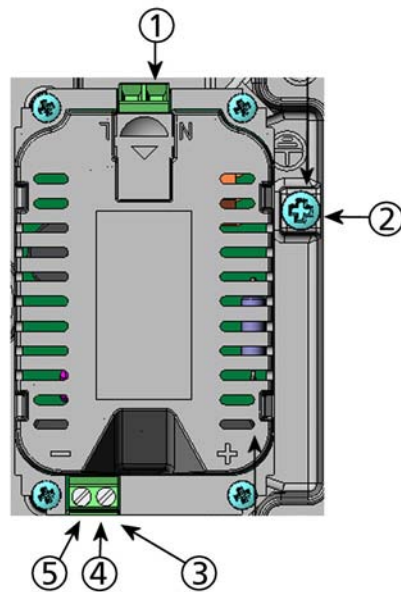
CAUTION

In case you have only one AC supply, never connect same wire to the + connector of a transmitter and to the - connector of another one. This will short-circuit the transformer.

Optional Modules

Power Supply Module

The mains power connection may be connected to the power supply module only by an authorized electrician. A readily accessible disconnect device shall be incorporated in the fixed wiring.



0605-030

Figure 28 Power Supply Module

Numbers refer to Figure 28 above:

- 1 = Connect AC mains voltage wires to these terminals
- 2 = Grounding terminal
- 3 = In case the module is not installed in the factory: Connect wires from these terminals to the **POWER 10 ... 35V = 24 V~** terminals of the motherboard.
- 4 = +
- 5 = -

Installation

1. Disconnect the power.
2. Remove the protective plug from the cable gland and thread the wires. In case the power supply module is installed in the factory, continue with the step 5.
3. To attach the module, open the transmitter cover and fasten the power module to the bottom of the housing with four screws. See the position from section Basic Features and Options on page 17.
4. Connect the wires from the terminals of the power supply module marked with + and - to the terminals **POWER 10 ... 35V = 24 V~** on the motherboard of the transmitter.

5. Connect the AC mains voltage wires to the power supply module terminals marked with **N** and **L**.
6. Attach the grounding wire to the grounding terminal on the right-hand side of the transmitter.
7. Connect the power. The LED on the cover of the transmitter is lit continuously during normal operation.

WARNING

Do not detach the power supply module from the transmitter when the power is on.

WARNING

Do not connect the mains power to power supply module when it is not installed in the transmitter.

WARNING

Always connect protective ground terminal.

Warnings

Questo prodotto é conforme alla Direttiva sul basso voltaggio (73/23 CEE).

- La conduttura elettrica può essere collegata al modulo di alimentazione elettrica soltanto da un elettricista autorizzato.
- Non staccare l'alimentazione elettrica dal trasmettitore quando é acceso.
- Non collegare la corrente elettrica al modulo di alimentazione elettrica se non é installato nel trasmettitore HMT330.
- Collegare sempre il morsetto protettivo a terra!

Dette produkt er i overensstemmelse med direktivet om lavspænding (73/23 EØS).

- Netstrømskoblingen til må kun tilsluttes strømforsyningsmodulet af en autoriseret elinstallatør
- Strømforsyningsmodulet må ikke løsføres fra senderen, mens spændingen er sluttet til.
- Slut ikke netspændingen til strømforsyningsmodulet, når det ikke er installeret i HMT330-senderen
- Forbind altid den beskyttende jordklemme!

Dit product voldoet aan de eisen van de richtlijn 73/23 EEG (Laagspanningsrichtlijn).

- De stroom kan aan de stroomtoevoer module aangesloten worden alleen door een bevoegde monteur.
- Het is niet toegestaan de stroomtoevoer module van de transmitter los te koppelen wanneer de stroom aan is.
- Het is niet toegestaan de stroom aan de stroomtoevoer module aan te sluiten als deze niet in een HMT330-transmitter is gemonteerd.
- Altijd beschermend aardcontact aansluiten!

Este producto cumple con la directiva de bajo voltaje (72/23 EEC).

- La conexión de la alimentación principal al módulo de alimentación sólo puede realizarla un electricista autorizado.
- No desenchufe el módulo de alimentación del transmisor cuando esté encendido.
- No conecte la alimentación principal al módulo de alimentación cuando no esté instalado en el transmisor HMT330.
- Conecte siempre el terminal de protección de conexión a tierra.

See toode vastab madalpinge direktiivile(73/23 EEC).

- Voolukaabli võib vooluallika mooduli külge ühendada ainult volitatud elektrik.
- Ärge ühendage vooluallika moodulit saatja küljest lahti, kui vool on sisse lülitatud.
- Ärge ühendage voolukaablit vooluallika mooduli külge, kui seda pole HMT330-tüüpi saatjasse paigaldatud.
- Ühendage alati kaitsev maandusklemm!

Ez a termék megfelel a Kisfeszültségű villamos termékek irányelvnek (73/23/EGK).

- A hálózati feszültséget csak feljogosított elektrotechnikus csatlakoztathatja a tápegységmodulra.
- A bekapcsolt távadóról ne csatolja le a tápegységmodult.
- Ne csatlakoztassa a hálózati feszültséget a tápegységmodulhoz, ha az nincs beépítve a HMT330 távadóba.
- Feltétlenül csatlakoztasson földelő védőkapcsot!

Šis produktas atitinka direktyvą dėl žemos įtampos prietaisų (73/23/EB).

- Elektros tinklą su energijos tiekimo modulių sujungti gali tik įgaliotas elektrikas.
- Niekada neišimkite energijos tiekimo modulio iš siūstuvo, kai maitinimas yra įjungtas.
- Jei energijos tiekimo modulis nėra įmontuotas HMT330 siūstuve, nejunkite jo į elektros tinklą.
- Visada prijunkite prie apsauginės įžeminimo jungties!

Šis produkts atbilst Zemsprieguma direktīvai (73/23 EEC).

- Strāvas pieslēgumu var pieslēgt pie barošanas avota moduļa tikai autorizēts elektriķis.
- Neatvienot barošanas avota moduli no raidītāja, kad pieslēgta strāva.
- Nepievienot strāvu barošanas avota modulim, ja tas nav uzstādēts HMT330 raidītājā
- Vienmēr pievienot aizsargājošu iezemētu terminālu !

Ten produkt spełnia wymogi Dyrektywy niskonapięciowej (73/23 EEC).

- Napięcie zasilające powinno zostać podłączone do modułu zasilacza tylko przez wykwalifikowanego elektryka.
- Nie wolno odłączać modułu zasilacza od nadajnika, kiedy zasilanie jest włączone.
- Nie wolno podłączać napięcia zasilającego do modułu zasilacza, kiedy nie jest on zamontowany w nadajniku HMT330.
- Zawsze należy podłączać zabezpieczający zacisk uziemiający!

Tento výrobek vyhovuje Směrnici pro nízké napětí (73/23 EEC).

- Připojení síťového napájení k napájecímu modulu smí provádět pouze oprávněný elektrikář.
- Neodpojujte napájecí modul od snímače při zapnutém napájení.
- Nepřipojujte síťové napájení k napájecímu modulu, pokud není instalován ve snímači HMT330.
- Vždy zapojte ochrannou zemnicí svorku!

Galvanic Isolation for Output

If galvanic isolation of the power supply line from the output signals is needed, DMT346 can be ordered with optional output isolation module. This module prevents harmful grounding loops.

NOTE

Output isolation module is not needed when using the power supply module.

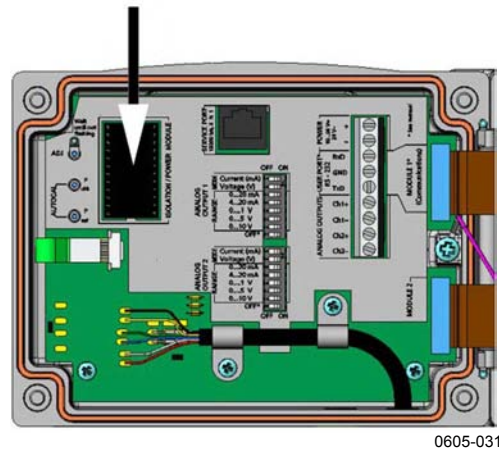


Figure 29 Galvanic Output Isolation Module

Alarm Relays

DMT346 can be equipped with one or two configurable relay modules. Each module contains two configurable relays. See the contact ratings in section Technical Specifications of Optional Modules on page 131.

Installation and Wiring

1. Disconnect the power. In case the relay-module is installed in the factory, continue with the step 5.
2. To attach the module, open the transmitter cover and fasten the relay module to the bottom of the housing with four screws. See the position in Figure 2 on page 19.
3. When the mains power is in use attach the grounding wire to the grounding terminal.
4. Connect the flat cable between the relay module and the motherboard's pins **MODULE 2** or **MODULE 1**.
5. Take out the protective plug from the cable gland and thread the relay wires.
6. Connect the wires to the screw terminals: **NO**, **C**, **NC**.

Selecting Relay Activation State

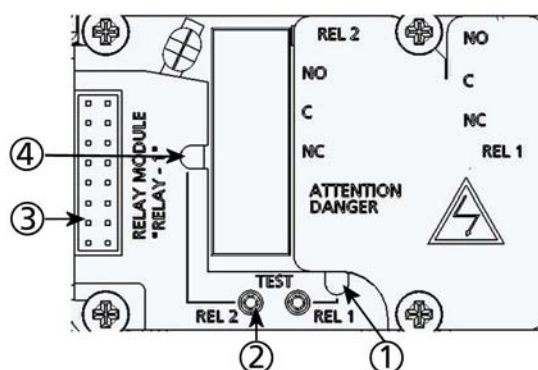
The middlemost **C** terminal and either one of the terminals **NO/NC** shall be connected. The polarity can be freely selected.

NO	Normally open
C	Common relay
NC	Normally closed

Relay NOT activated: **C** and **NC** outputs are closed, **NO** is open

Relay IS activated: **C** and **NO** outputs are closed, **NC** is open.

Connect the power and close the cover. For instructions on how to operate the relay (for example, select quantity for the relay output and set the relay setpoints) see section Relay Operation on page 91.



0605-032

Figure 30 Relay Module

Numbers refer to Figure 30 above:

- 1 = Indication led for the relay 1 or 3
- 2 = Relay test buttons
- 3 = Flat cable pins
- 4 = Indication led for relay 2 or 4

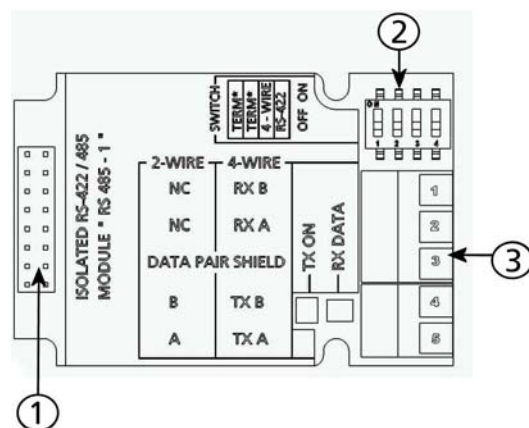
WARNING

The relay module may contain dangerous voltages even if the transmitter power has been disconnected. Before working on the relay module you must switch off **both** the transmitter **and** the voltage connected to the relay terminals.

WARNING

Do not connect the mains power to relay unit without grounding the transmitter.

RS-422/485 Interface



0605-033

Figure 31 RS-485 Module

Numbers refer to Figure 31 above:

- 1 = Flat cable pins
- 2 = Selection switches
- 3 = Screw terminals for wiring

Installation and Wiring

1. Disconnect the power. In case the RS-485-module is installed in the factory, continue with the item 4.
2. To attach the module, open the transmitter cover and fasten the RS-485 module to the bottom of the housing with four screws.
3. Connect the flat cable between the RS-485 module and the motherboard's pins **MODULE1 (Communications)**.
4. Pull the network wirings through the cable gland.
5. Connect the twisted pair wires (1 or 2 pairs) to the screw terminals as presented in Table 6 below:

Table 6 Connecting Twisted Pair Wires to Screw Terminals

Screw terminal	Data line (2-wire RS-485)	Data line (4-wire RS-485/422)
1	(not connected)	RxB
2	(not connected)	RxA
3	Data pair shield	Data pair shield
4	B	TxB
5	A	TxA

6. If you use RS-485 (or RS-422) to connect just one DMT346 to a master computer, enable the internal termination of DMT346 by switching switches 1 and 2 ON. Make sure that the master's end of the line is also terminated (by using master's internal termination or with a separate terminator).

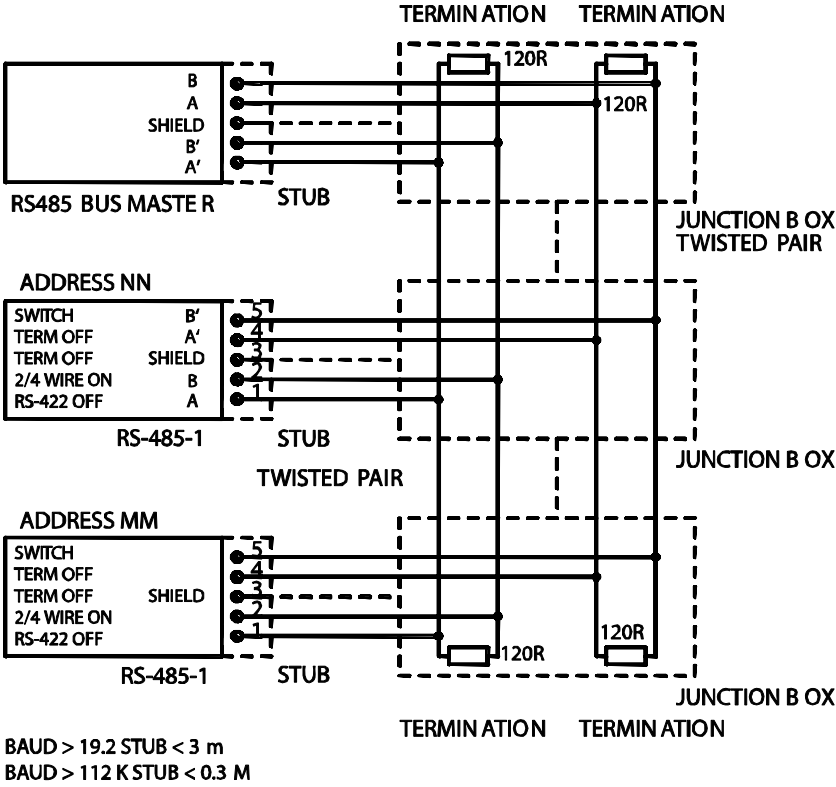
If you are connecting many transmitters to the same RS-485 bus, make sure that switches 1 and 2 are OFF and terminate the bus with separate terminators at both ends. This allows removing any transmitter without blocking the bus operation.

NOTE

If you use the internal termination of the transmitter at the end of the RS-485 bus (instead of using separate terminators) removing that transmitter will block the bus operation.

7. Use the bus type (4-wire/2-wire) to select the selection switch 3.

In 4-wire mode RS-485 master sends data to the DMT346 through terminals RxA and RxB and receives data from DMT346 through terminals TxA and TxB.



0605-034

Figure 32 4-Wire RS-485 Bus Connections, Part A

Table 7 4-Wire (Switch 3:On)

RS-485 master	Data	DMT346
TxA	→	RxA
TxB	→	RxB
RxA	←	TxA
RxB	←	TxB

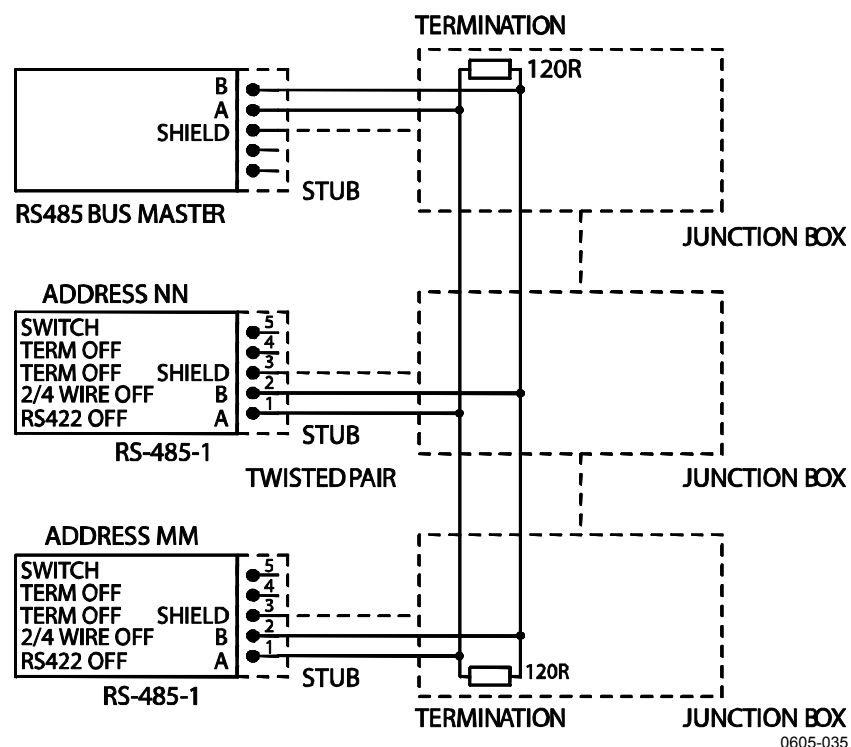


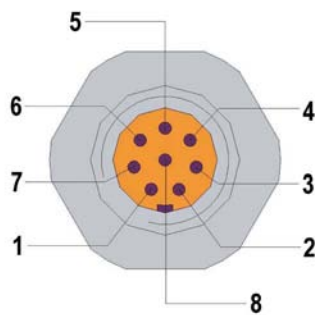
Figure 33 4-Wire RS-485 Bus Connections, Part B

Table 8 2-Wire (Switch 3:Off)

RS-485 master	Data	DMT346
A	↔	A
B	↔	B

8.
- When operating in communication mode RS-422, set both switches 3 and 4 to ON position (4-wire wiring is required for RS-422 mode).
9.
- Connect the power and close the cover.

8-Pin Connector



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Figure 34 Wiring of Optional 8-Pin Connector

Table 9 8-Pin Connector Wiring

PIN/Terminal	Wire	Serial Signal		Analog Signal
		RS-232 (EIA-232)	RS-485 (EIA-485)	
1	White	Data out TX	A –	-
2	Brown	(Serial GND)	(Serial GND)	Signal GND (for both channels)
3	Green	-	-	Ch 2 +
4	Yellow	-	-	Ch 1 +
5	Grey	Supply –	Supply –	Supply –
6	Pink	Supply +	Supply +	Supply +
7	Blue	Data in RX	B –	-
8	Shield/Red	Cable shield	Cable shield	Cable shield

CHAPTER 4

OPERATION

This chapter contains information that is needed to operate this product.

Getting Started

Within a few seconds after power-up the led on the cover of the transmitter is lit continuously indicating normal operation. When the transmitter is turned on the first time, the language selection window opens: Select the language with ▲ ▼ arrow buttons and press the **SELECT** button.

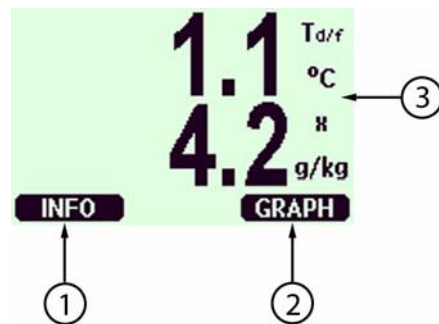
The pressure has an effect on humidity calculations and accuracy. Therefore, accurate calculations can be achieved only when the ambient pressure is taken into consideration. See section Pressure Compensation Setting on page 73 for instructions on how to set the pressure.

Start-up time for DMT345/346 transmitter is in total about 6 minutes. The outputs (serial and analog) are activated 3 seconds after powering up the transmitter. In addition, 10 seconds after the measurement the outputs will freeze for about 6 minutes due to the sensor self diagnostics procedure (Sensor Purge and AutoCal). The frozen output value will be the value the transmitter reached during the 10 seconds of measurement. After the self diagnostics procedure the outputs are operational again.

Display/Keypad

Basic Display

Display shows you the measurement values of the selected quantities in the selected units. You can select 1 ... 3 quantities for the numerical basic display (see section Changing Quantities and Units on page 70).



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Figure 35 Basic Display

The numbers refer to Figure 35 above:

- 1 = The **INFO** shortcut button
- 2 = The **GRAPH** shortcut button changes the display into a curve mode
- 3 = Selected quantities

Press the **INFO** button (in the basic display) to see the device information views, see section Device Information on page 79.

NOTE

From any view, a four-second press on the right-hand function button takes you directly to the basic display.

Graphic History

The graphical display shows the data trend of the selected quantities, one at a time. The graph is updated automatically while measuring. Use the following functions in the graphical display:

- Press the **NEXT** button to have the trend graph and max/min graph in turns.
- Press the **EXIT** button to get back the basic display.

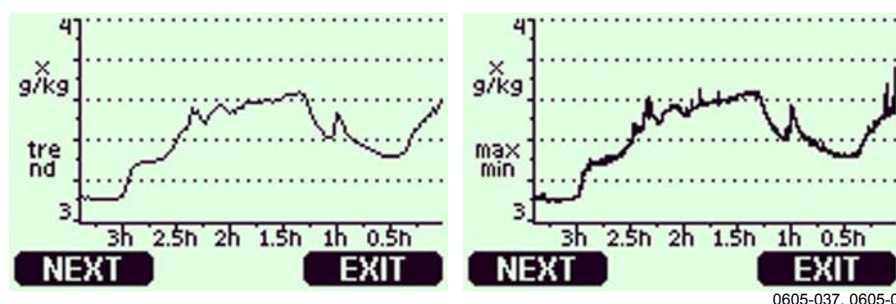


Figure 36 Graphical Display

Trend graph: Shows you a curve of average values. Each value is a calculated average over a period. See Table 10 below.

Max/min graph: Shows you the minimum and maximum values in a form of curve. Each value is max/min over a time period. See Table 10 below. The period for the trend and max/min calculations depends on the selected graph window as follows:

Table 10 Periods for Trend and Max/Min Calculations

Observation Period	Period for Trend/Max/Min Calculations (Resolution)
3 hours	1.5 minutes
1 day	12 minutes
10 days	2 hours
2 months	12 hours
1 year	3 days

- Press the **▲ ▼** arrow buttons to zoom in and out the time in the graph window.
- Press the **◀ ▶** arrow buttons to have a cursor mode where you can observe an individual measuring point. Press an arrow button to move a cursor (vertical bar) along the time axis. The numerical value at the cursor position is shown at the left upper corner. Time from the present to the chosen moment is shown at the right upper corner.

Table 11 Graph Information Messages

Failure Message	Interpretation
Power outage	Power failure (marked also with dashed vertical line)
No data	Quantity has not been selected for the display
Device failure	General device failure.
T meas. failure	Temperature measurement/sensor failure
RH meas. failure	Humidity measurement/sensor failure
Adj. mode active	Adjustment mode active (data recorded in the adjustment mode is not displayed)
Autocal	AutoCal performed (only shown in 3 h graphs)

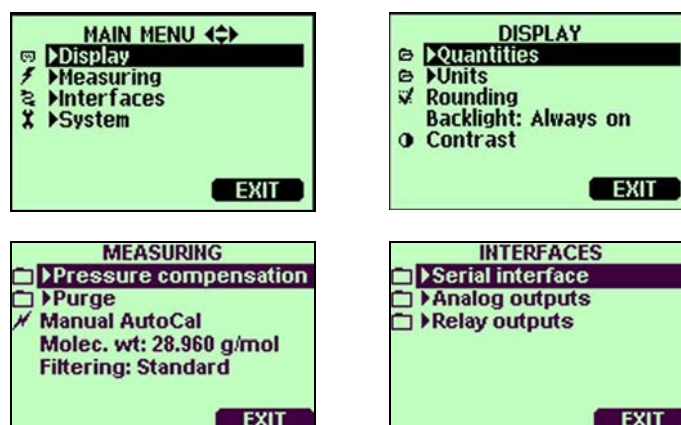
A question mark after time tells you that at least one power failure (dashed vertical line) has occurred after the chosen moment. In this case, the actual time difference between the present and the cursor position is not exactly known.

Menus and Navigation

You can change settings and select functions in the menus.

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons in the basic (numeric) display mode.
2. Move in the menus by using the ◀ ▶ arrow buttons.
3. Open a submenu with ► button.
4. Press ◀ to return to the previous level.
5. Function button **EXIT** returns you back to the basic display.

Adjustment menu is displayed only when **ADJ** button (on the motherboard inside the transmitter) is pressed.



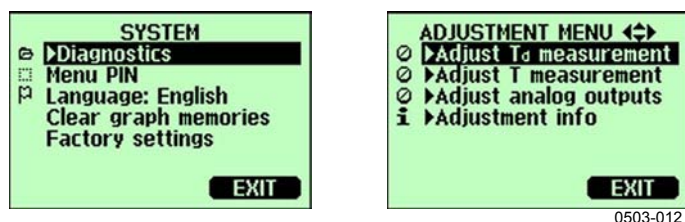


Figure 37 Main Views

Changing Language Setting

1. Go back to the basic display by keeping the right-hand button pressed for four seconds.
2. Open the **MAIN MENU** by pressing any of the buttons.
3. Select **System** (the lowest row), press button.
4. Select **Language: ...** (the third row marked with a flag icon), press **SELECT** button (left-hand button).
5. Select the language with buttons and press **SELECT** button (left-hand button).
6. Press **EXIT** to return to the basic display.

Rounding Setting

Round off one decimal by using the Rounding function . The default setting is rounding on. Rounding has no effect on quantities without decimals.

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons.
2. Select **Display** and confirm by pressing the arrow button.
3. Select **Rounding** and press **ON/OFF** button.
4. Press **EXIT** to return to the basic display.

Display Backlight Setting

As a default the display backlight is always on. In the automatic mode the backlight stays on for 30 seconds from the last press of the button. When pressing any button, the light turns on again.

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons.
2. Select **Display**, press the arrow button.
3. Select **Backlight**, press the **CHANGE** button.
4. Select **On/Off/ Automatic**, press the **SELECT** button.
5. Press **EXIT** to return to the basic display.

Display Contrast Setting

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons.
2. Select **Display**, press the arrow button.
3. Select **Contrast**, press the **ADJUST** button.
4. Adjust the contrast by pressing the ◀ ▶ arrow buttons.
5. Press **OK** and **EXIT** to return to the basic display.

Keypad Lock (Keyguard)

This function locks the keypad and prevents unintentional key presses.

1. Keep pressing the left-hand function button for 4 seconds to lock the keypad (at any display).
2. To unlock the keypad, press the **OPEN** button for 4 seconds.

Menu PIN Lock

You can prevent unauthorized changes of the device settings by activating the menu PIN lock. When this function is activated, the basic display and graphical view are available but access to the menus is locked. The key symbol indicates the activation of this feature.

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons.
2. Select **System**, press the arrow button.
3. Select **Menu PIN**, press the **ON** button.
4. Enter a PIN code by using the ▲ ▼ arrow buttons. Press **OK** to confirm the setting. Now the PIN lock is on and a key symbol is shown in a display.

5. Press **EXIT** to return to the basic display. Returning to the menu is possible only by entering the correct PIN code.

When you want to turn off the PIN lock, go to the menu by giving the PIN code and select **System, Menu PIN**, press **OFF** button.

In case you have forgotten the PIN code, open the transmitter cover and press the **ADJ** button once. Wait for a few seconds and the adjustment menu opens. Select **Clear menu PIN**, press **CLEAR**.

NOTE

You can also disable the keypad completely with serial command **LOCK**.

Factory Settings

Use the display/keypad to restore the factory settings. This operation does not affect the adjustments. Only settings available in the menus are restored.

1. Open the **MAIN MENU** by pressing any of the **▲ ▼ ◀ ▶** arrow buttons.
2. Select **System** by pressing the **▶** arrow button.
3. Select **Factory settings** and press the **REVERT** button to confirm your selection. Press the **YES** button to reset all settings to the factory defaults.

See section General Settings on page 70 for a description of the other menu options.

MI70 Link Program for Data Handling

The recorded data can be transferred to a PC by using MI70 Link program. You can examine the recorded data easily in Windows[®] environment and transfer it further to a spreadsheet program (such as Microsoft[®] Excel) or virtually to any Windows[®] program in numeric or graphical format. MI70 Link program allows you also to monitor transmitter readings directly with a PC (real-time window function).

MI70 Link program is available from Vaisala, see Table 42 Available Spare Parts on page 134 for a list of accessories.

1. Connect the connection cable between the serial port of your PC and the Service Port of DMT346, see Figure 38 below.
2. Check that the DMT346 is powered and start using the MI70 Link program.

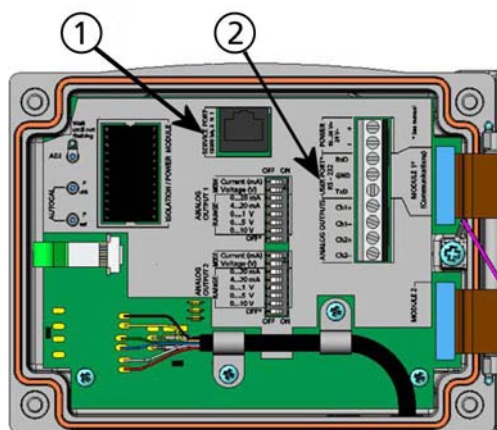
Use a MI70 Link version 1.07, or a newer one, to be able to utilize all the functions of DMT346.

Serial Line Communication

Connect the serial interface by using either the user port or the service port.

For permanent interfacing to host system, use the user port. You can change the serial settings and operate in RUN, STOP and POLL modes.

For temporary RS-232 connections use the service port. Service port is always available with fixed serial settings.



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Figure 38 Service Port Connector and User Port Terminal on the Motherboard

Numbers refer to Figure 38 above:

- 1 = Service port connector
- 2 = User Port Terminals

User Port Connection

Use suitable serial cable between the user port RxD, GND and TxD screw terminals and the PC serial port.

Table 12 Default Serial Communication Settings for User Port

Parameter	Value
Bauds	4800
Parity	Even
Data bits	7
Stop bits	1
Flow control	None

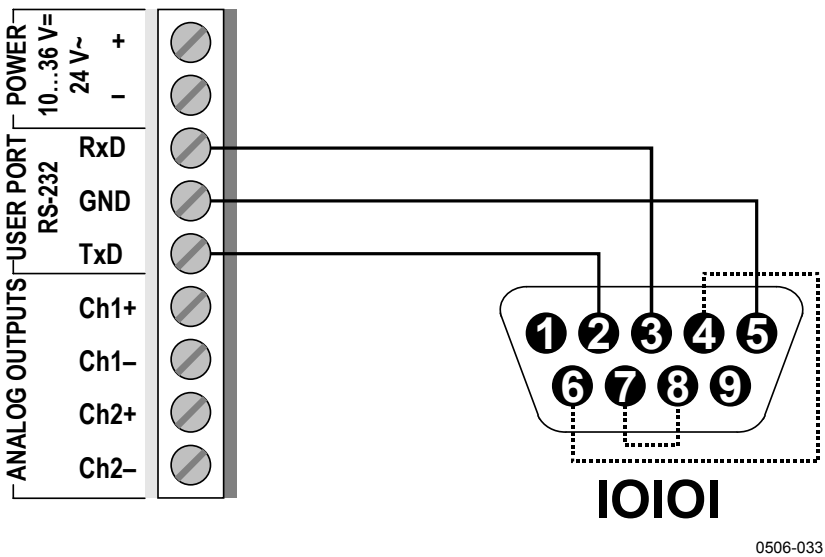


Figure 39 Connection Example Between PC Serial Port and User Port

Connections to pins 4,6,7 and 8 are required only if your software requires hardware handshaking.

NOTE

User port cannot be used when RS-485 module is connected.

Service Port Connection

1. Connect the serial interface cable (optional accessory, order code: 19446ZZ) between the serial port of your PC and the service port connector on the motherboard, see Figure 39 above.
2. Power-up the DMT346.

3. Open a terminal program and set the communication settings (see the following section for more detailed instructions).

Table 13 Fixed Communication Settings for Service Port

Parameter	Value
Bauds	19200
Parity	None
Data bits	8
Stop bits	1
Flow control	None

Terminal Program Settings

The following instructions show a connection example with HyperTerminal program (included in the Microsoft® Windows®).

Follow the instructions below to open a HyperTerminal program:

1. Start HyperTerminal. To get help for starting HyperTerminal, click "Start", select "Help" to open Windows® help, and search for "HyperTerminal".



Figure 40 Starting Hyper Terminal Connection

2. In the "New Connection" window of the HyperTerminal, define a name for DMT346 serial connection, for example "DMT346". Click OK.
3. In "Connect using" box, select the PC communications port where the serial cable is connected. (If your computer has only one COM port, it is called "COM1".) Click OK.



Figure 41 Connecting to Hyper Terminal

4. Set the port settings in the "Properties" window to match the settings of your DMT346 *user port/service port*. For DMT346, "Flow control" must always be set to "None". Finally click OK to start using the serial connection.

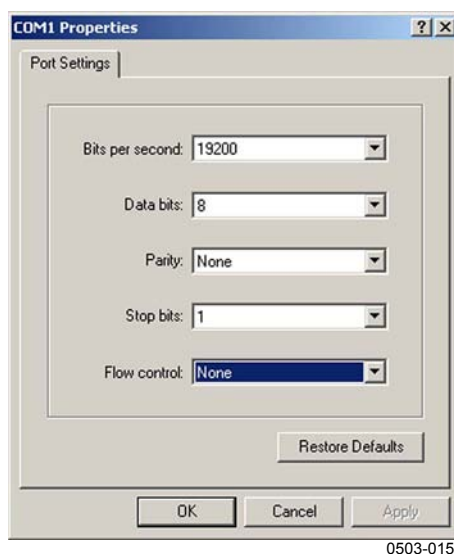


Figure 42 Hyper Terminal Serial Port Settings

5. Select "File" → "Save" in the HyperTerminal main window to save the serial port settings. To use the saved settings later, start HyperTerminal, click cancel in the "New Connection" window, and select "File" → "Open".

After power-up transmitter (in STOP-mode) outputs a prompt message:

```
DMT346/2.01
>
```

In RUN mode a measurement output starts immediately after power-up.

List of Serial Commands

The **bold** text in the brackets indicates the default setting. Issue commands by typing them on your computer and pressing the Enter key.

Table 14 Measurement Commands

Command	Description
R	Start the Continuous Outputting
S	Stop the Continuous Outputting
INTV [0 ... 255 S /MIN/H]	Set the Continuous Output Interval (for RUN mode)
SEND [0 ... 99]	Output the Reading once
SMODE [STOP /RUN/POLL/SEND]	Set the Serial Interface mode
SERI [baud p d s]	User Port Settings (Default: 4800 E 7 1)
ADDR [0 ... 99]	Set the Transmitter Address (for POLL Mode)
OPEN [0 ... 99]	Open Temporarily Connection to a POLL Mode Device
CLOSE	Close the Temporary Connection (Back to POLL Mode)

Table 15 Formatting Commands

Command	Description
FORM	Set the output format of SEND and R commands
FST	Add the state of AutoCal, purge and sensor warming in connection with SEND and R commands
FDATE	Add date to R and SEND outputs
FTIME	Add time to output to SEND and R outputs

Table 16 Data Recording Commands

Command	Description
DIR	Lists trend log files
PLAY [-1 ... 14]	Outputs log file
DSEL	Select logged (and displayed) quantities

Table 17 Purge Commands

Command	Description
PUR	Purge settings
PURGE	Start manual purge

Table 18 Autocalibration Commands

Command	Description
AUTO	AutoCal settings
AUTOCAL	Start manual AutoCal

Table 19 Calibration and Adjustment Commands

Command	Description
FCRH	RH 2-point-adjustment
AØ1	Td/f 1-point-adjustment
CT	T 1/2-point-adjustment
ACAL	Perform analog output adjustment

Table 20 Setting and Testing the Analog Outputs

Command	Description
ASEL	Configure analog output quantities and scales
ITEST	Test analog outputs
AMODE	Display analog output mode
AERR	Change the error output
ASCL	Analog output scaling

Table 21 Setting and Testing the Relays

Command	Description
RSEL	Configure relay settings
RTEST	Test relays

Table 22 Other Commands

Command	Description
?	Output the information about the device
??	Output the information about the device in POLL-state
CDATE	Display the output date/set date when adjustment enabled
CODE	Display the order configuration code of the transmitter
CTEXT	Display the adjustment information text/set information text when adjustment enabled
DATE	Set date.
DELETE	Clear/delete trend log data
DSEND	Output the reading, also in poll mode.
ECHO	Turn the serial interface echo ON/OFF
ERRS	Display transmitter error messages
HELP	List the most common commands
LOCK	Lock the menu/keypad
MODS	Display module status
PRES	Set the value for pressure compensation
RESET	Reset the device
TEST	Self-diagnostics information
TIME	Set time.
UNDELETE	Restore data
UNIT	Display output units
VERS	Display the software version information
XPRES	Set pressure (temporarily)
MOL/MOLI	View/set mole weight parameter

Getting Measurement Message from Serial Line

Press **R** to start output of measurements. Press **S**, the Esc button or reset the transmitter to stop outputting. See command **SMODE** to change the default (power-up) operation mode.

Format the output by using the following commands:

- resulting interval can be changed with the command **INTV**.
- output string format can be changed with the command **FORM**.
- status of purge, sensor warming and autocalibration can be added with the command **FST**.
- date and time information can be added with commands **FDATE** and **FTIME**.

Example:

```
>r
Tdf=-20.6 'C H2O= 958 ppmV x= 0.6 g/kg

>r
Tdf=-20.7 'C H2O= 958 ppmV T= 23.8 'C RH= 3.3 %RH
>
```

To end the RUN mode issue the **S** command. After this, all other commands can be used.

To output the reading once in STOP mode issue the **SEND** command.

If value is too long to fit to the allocated space or if there is an error in outputting the quantity, value is displayed with stars '*'.

The output mode can be changed with the commands: **FORM**, **FST**, **FDATE**, **TIME**.

TIME and DATE

You can format the serial line message by using the **TIME** and **DATE** commands. To set time issue the **TIME** command. To set date issue the **DATE** command.

These time and date settings are shown on the timestamps of **PLAY** command. When you want to include time and date in the **R** and **SEND** commands, use the **FTIME** and **FDATE** commands.

Syntax:

TIME

DATE

Example:

```
>time
Current time is 04:12:39
Enter new time (hh:mm:ss) ? 12:24:00
>date
Current date is 2000-01-01
Enter new date (yyyy-mm-dd) ? 2004-07-05
>
```

NOTE

Time and date are cleared to 2000-01-01 00:00:00 at reset or at power failure.

FTIME and FDATE

FTIME and **FDATE** commands will enable/disable output of time and date to the serial line. To add time to R and SEND outputs issue command **FTIME** [x].

Syntax:

FTIME

Syntax: to add date to **R** and **SEND** outputs:

FDATE [x]

where

x = ON or OFF

Example:

```
>send
RH= 16.2 %RH T= 22.0 'C
>ftime on
Form. time      : ON
>send
00:03:56 RH= 16.2 %RH T= 22.0 'C
>fdate on
Form. date      : ON
>send
2000-01-01 00:04:08 RH= 16.2 %RH T= 22.0 'C
>
```

FST

To output the state of purge, sensor warming and AutoCal in connections with **SEND** and **R** commands issue command **FST** [x].

Syntax: **FST** [x]

where

x = ON or OFF (default)

Example:

```
>fst on
Form. status    : ON
>send
w      0 Tdf=   0.6 'C x=   4.0 g/kg  SSR= 22.5 %  Ts=
23.2 'C
>
```

N ... xxx =	Normal operation	where xxx = Probe heat power
H ... xxx =	Purge	where xxx = Sensor temperature (°C)
S ... xxx =	Sensor cooling after purge	where xxx = Sensor temperature (°C)
A ... xxx =	AutoCal	where xxx = Sensor temperature (°C)
w ... xxx =	Sensor warming	where xxx = Sensor heat power

Resetting the Device

Use the serial line to reset the device. Use the command **RESET** to reset the device. The user port switches to start-up output mode selected with command **SMODE**.

Keypad/Menu Locks

LOCK

Use the **LOCK** [x] command to turn on the menu lock.

Syntax: **LOCK** [x]

where

x = 1 (Menu locked)

Example:

```
>lock 1
Keyboard lock : 1
>
```

Use the **LOCK** [x yyyy] command to turn on the menu lock with 4-digit PIN code, for example 4444.

Syntax: **LOCK** [x yyyy]

where

x = 1 (Menu locked)

yyyy = 4-digit PIN code

Example:

```
>lock 1 4444
Keyboard lock : 1 [4444]
>
```

Use the **LOCK** [x] command to disable the keypad completely.

Syntax: **LOCK** [x]

where

x = 2 (Keypad disabled)

Example:

```
>lock 2
Keyboard lock : 2
>
```

NOTE

Open the locks with the serial command **LOCK 0**. You can open the menu lock also by using the keypad, provided a PIN code has been set.

See section General Settings below for a description of the other serial commands.

General Settings

Changing Quantities and Units

To change quantities and units use serial commands or the optional display/keypad. See Table 5 on page 16 for available quantities.

NOTE

Only the quantities selected when ordering the device can be selected as an output quantity.

Use display/keypad to select the display output quantities.

1. Open the **MAIN MENU** by pressing any of the ▲▼◀▶ arrow buttons.
2. Press the ▶ arrow button to select **Display**.
3. Press ▶ arrow button to select **Quantities**.

4. Select the quantity by using the ▲▼ arrow buttons. Confirm the selection by pressing **SELECT**. You can select 1 ... 3 display quantities at a time.
5. Press **EXIT** to return to the basic display.

To select display units:

1. Open the **MAIN MENU** by pressing any of the ▲▼◀▶ arrow buttons.
2. Press the ▶ arrow button to select **Display**.
3. Use the ▲▼ arrow buttons to select Units. Confirm the selection by pressing the right-hand arrow button.
4. Use the ▲▼ arrow buttons to select display units. Confirm the selection by pressing **CHANGE**. The unit changes from metric to non-metric or the other way round.
5. Press **EXIT** to return to the basic display.

NOTE

Changing the units by using the display/keypad has no effect on the serial output units.

FORM

Use the serial line command **FORM** to change the format or select a certain quantities for the output commands **SEND** and **R**.

Syntax: **FORM** [x]

where

x = Formatter string

Formatter string consists of quantities and modifiers. When selecting the quantity, use the abbreviations of the quantities presented in Table 5 on page 16 when issuing the command. The modifiers are presented in Table 23 below.

Table 23 Modifiers

Modifier	Description
x.y	Length modifier (number of digits and decimal places)
#t	Tabulator
#r	Carriage-return
#n	Line feed
""	String constant
#xxx	Special character, code "xxx" (decimal), for example

Modifier	Description
	#027 for ESC
U5	Unit field and length
ADDR	Transmitter address with two characters [00...99]
ERR	Error flags for P, T, Ta, RH [0000 ... 1111], 0 = no error
STAT	Transmitter status in 7 character field, for example: N 0 no heating h 115 probe heating active, power 115/255 H 159.0 purge heating active, temperature 159°C S 115.0 purge cooling active, temperature 115°C X 95.0 sensor heating active, temperature 95°C
SN	Transmitter serial number
TIME	Time [hh:mm:ss]
DATE	Date [yyyy-mm-dd]
OK	Pressure stability indicator, two characters [OK or " "]
CS2	Modulus-256 checksum of message sent so far, ascii encoded hexadecimal notation
CS4	Modulus-65536 checksum of message sent so far, ascii encoded hexadecimal notation
CSX	NMEA xor-checksum of message sent so far, ascii encoded hexadecimal notation
A3H	Pressure tendency [* or 0...8]

Example:

```
>form "SSR=" 4.2 ssr U5 #t "Ts=" ts U3 #r #n
OK
>
>send
SSR= 22.51% Ts= 23.14'C
>
```

Command '**FORM** /' will return the default output format. The default output format depends on the device configuration.

```
>form /
OK
>send
Tdf= 0.5 'C x= 4.0 g/kg SSR= 22.4 % Ts= 23.1 'C
>
```

UNIT

Use the command **UNIT** [x] to select metric or non-metric output units.

Syntax: **UNIT** [x]

where

x = M or N
M = metric units
N = nonmetric units

NOTE

This command changes both the serial output and display units to either metric or non-metric units. When you want to output both metric and non-metric units simultaneously on the display, select the display units by using the display/keypad.

Pressure Compensation Setting

The pressure has an effect on humidity calculations and accuracy. Therefore, accurate calculations can be achieved only when the process pressure is taken into consideration. If you are using mixing ratio as an output quantity, it is recommended that you make the pressure compensation setting.

Note that conversions from mmHg and inHg are defined at 0°C and for mmH₂O and inH₂O at 4°C.

NOTE

Pressure compensation is intended to be used in normal air only. When measuring in other gases, please contact Vaisala for further information.

NOTE

Fixed pressure compensation value of 1013.25 hPa is used when in adjustment mode.

Using Display/Keypad

Use display/keypad to set the pressure compensation. To select the pressure unit using display/keypad see section Changing Quantities and Units on page 70.

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons.
2. Select **Measuring** and press the ▶ arrow button to confirm your selection.
3. Select Pressure compensation and press the ▶ arrow button to confirm you selection.
4. Press **SET** and enter the pressure value by using the arrow buttons.
5. Press **OK** and **EXIT** to return to the basic display.

Using Buttons on Motherboard

Pressure set buttons (P_{chk} and P_{set}) can be used to set the process pressure.

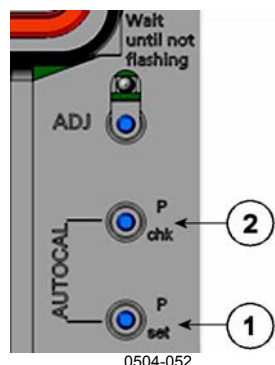


Figure 43 Pressure Set Buttons on Motherboard

Numbers refer to Figure 43 above:

- 1 = Pressure check button
- 2 = Pressure set button

Press check button (P_{chk}) and a red led will flash the current pressure setting in bar_a .

Press the set button (P_{set}) to set the pressure value. The number of presses equals the number of bar_a to be set (for example, three presses = three bar_a). After a few seconds, the red led will confirm the setting by flashing the new pressure value.

Using Serial Line

XPRES and PRES

Command **XPRES** should be used if the value is changed frequently. Its value is not retained at reset, and when set to 0, last value set with **PRES** is used instead.

Syntax:

PRES [aaaa.a]

XPRES [aaaa.a]

where

aaaa.a = Absolute process pressure (hPa)

Example:

```
>pres
Pressure      : 1013.00 hPa ?
>pres 1010
Pressure      : 1010.00 hPa
>
```

Table 24 Multiplication Factors

From	To: hPa
mbar	1
PaN/m2	0.01
mmHg torr	1.333224
inHg	33.86388
mmH ₂ O	0.09806650
inH ₂ O	2.490889
atm	1013.25
at	980.665
bar	1000
psi _a ¹⁾	68.94757

1) psi_a = psi absolute

Example:

29.9213 inHg = 29.9213 × 33.86388 hPa = 1013.25 hPa

User Port Serial Settings

The communication settings for the user port can be changed via the serial line or by using the optional display/keypad. The communication settings for the service port are fixed and not changeable.

1. Open the **MAIN MENU** by pressing any of the ▲▼◀▶ arrow buttons.
2. Select **Interfaces** and press the ▶ arrow button to confirm your selection.
3. Select **Serial interface** and press the ▶ arrow button to confirm your selection.
4. Select **Bit rate/Serial format/Comm. mode** by pressing the **CHANGE** button. Use the ▲▼ arrow buttons to select and press **SELECT** to confirm your selection.

5. Select **RUN** interval for RUN communication mode and press **SET** to confirm your selection.
6. Use the arrow buttons to set the measuring interval and the unit. Press **OK** to confirm your settings.
7. Select **POLL** address for **POLL** communication mode. Press **SET** to confirm your selection.
8. Use the arrow buttons to set the transmitter address. Press **OK** to confirm the setting.
9. Use the arrow buttons to select **ECHO**. Press **ON** to turn it on. Press **OFF** to turn it off.
10. Press **EXIT** to return to the basic display.

SERI

Use the serial line command **SERI** [*b p d s*] to set communication settings for the user port.

Syntax: **SERI** [*b p d s*]

where

b = Bauds (110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200)
p = Parity (n = none, e = even, o = odd)
d = Data bits (7 or 8)
s = Stop bits (1 or 2)

Example:

```
>SERI 600 N 8 1
600 N 8 1
>
```

SMODE

Use the command **SMODE** [*xxxx*] to set the user port start-up operating mode.

Syntax: **SMODE** [*xxxx*]

where

xxxx = STOP, RUN, POLL or SEND

Table 25 Selection of Output Modes

Mode	Output	Commands used
STOP	Only by command	All (default mode)
RUN	Automatic output	Only command S
POLL	Only with command SEND [addr]	Use with RS-485 buses, see RS-422/485 Interface on page 48.
SEND	One message at power-up	

Selected output mode will be activated after power outages.

INTV

Use the command **INTV**[xxx yyy] to set the outputting interval for the RUN mode.

Syntax: **INTV**[xxx yyy]

where

xxx = Output interval (0 ... 255). 0: the fastest possible output rate.
 yyy = Unit (s, min or h)

Example:

```
>INTV 10 min
Output intrv. : 10 min
>
```

ECHO

Use the command **ECHO** [x] to set the user port echo. The command either enables or disables echo of characters received.

Syntax: **ECHO** [x]

where

x = ON (default) or
 = OFF

NOTE

You can use the SERI, SMODE, INTV and ECHO commands to change/view the user port settings even if you are currently connected to the service port.

Data Filtering

The averaging data filter calculates a average over a certain period of time. The lowest measurement noise is achieved with the extended filtering. There are three filtering levels available.

Table 26 Filtering Levels

Setting	Filtering level
OFF	No filtering
ON (default)	Standard = short filtering (about 15 s moving average)
EXTENDED	Extended filtering (default: 1 min average)

Use display/keypad to set the filtering level.

1. Open the **MAIN MENU** by pressing any of the **▲ ▼ ◀ ▶** arrow buttons.
2. Select **Measuring** by pressing the **▶** arrow button.
3. Select **Filtering** and press **CHANGE** to confirm your selection.
4. Select **Off/Standard/Extended** and press **SELECT** to confirm your selection.
5. Press **EXIT** to return to the basic display.

FILT

Set the filtering level.

Syntax: **FILT** [xxx]

where

xxx = OFF, ON or EXT (default = ON)

Device Information

Use the display/keypad or the serial line to display the device information.

Press the **INFO** button in the basic display to see the following information:

- current sensor operation (for example, AutoCal or Purge) in progress
- present or past unacknowledged errors
- device information
- adjustment information fed by the user
- measuring settings
- information on Purge settings
- serial interface information
- analog output information
- relay output information



Figure 44 Following Device Information on the Display

Proceed in the information views by pressing the **MORE** button as many times as you get the desired information. You can browse through the information displays also with arrow buttons. Press **OK** to return to the basic display.

?

Use the serial line command **?** to check the current transmitter configuration. Command **??** is similar but can also be used if the transmitter is in POLL mode.

Example:

```
>?
DMT340 / 3.01
Serial number   : A3220001
Batch number    : A3120029
Adjust. date    : 2005-08-09
Adjust. info    : Vaisala/HEL
Date            : 2000-01-01
Time            : 00:42:41
Serial mode     : STOP
Baud P D S      : 4800 E 7 1
Output interval: 0 s
Address         : 0
Echo            : ON
Pressure        : 1000.00 hPa
Filter          : ON
Ch1 output      : 4...20mA
Ch2 output      : 4...20mA
Ch1 Tdf low     : 0.00 'C
Ch1 Tdf high    : 100.00 'C
Ch2 x low       : 0.00 g/kg
Ch2 x high      : 1000.00 g/kg
Module 1        : not installed
Module 2        : not installed
>
```

HELP

Use the command **HELP** to list the commands.

```
>help
?          ACAL      ADDR      AERR      ASCL
ASEL       CDATE     CLOSE     CODE      CRH
CT         CTA       CTEXT     DATE      DELETE
DIR        DSEL      DSEND     ECHO      ERRS
FCRH       FDATE     FILT      FORM      FST
FTIME      HELP      INTV      ITEST     MODS
OPEN       PLAY      PRES      R          RESET
SEND       SERI      SMODE     TEST      TIME
UNDELETE   UNIT      VERS      XPRES
>
```

ERRS

Use the command **ERRS** to display transmitter error messages, see Table 28 on page 122.

Examples:

```
>ERRS
NO ERRORS
>
```

```
>ERRS
FAIL
Error: Temperature measurement malfunction
Error: Humidity sensor open circuit
>
```

VERS

Use the command **VERS** to display software version information.

Example:

```
>vers
DMT346 / 3.01
>
```

Data Recording

Data recording function is always on and collects data automatically into the memory of the device. Recorded data do not disappear from the memory when the power is switched off. Collected data can be observed in a form of a graph in the graphical view of the display or it can be listed out by using the serial line or MI70 Link program.

Selecting Data Recording Quantities

If the device is provided with the optional display, the recorded quantities are always those selected for the display. Up to three quantities can be recorded at a time. See section Changing Quantities and Units on page 70 for instructions on how to select the display quantities with the keypad.

DSEL

Use the serial line command **DSEL** [xxx] to select the quantities to be recorded if the transmitter is not equipped with display/keypad.

You may also dump the logged data to the serial line in numeric form with the following commands.

Syntax: **DSEL** [xxx]

where

xxx = Data recording quantity. See Table 5 on page 16 for output available quantities.

Issue the command without parameters and press Enter to display current recording parameters.

Example:

```
>dset tdf x
  Tdf x
>dset
  Tdf x
>
```

View Recorded Data

If the device is provided with the optional display, the graphical display shows the data of the selected quantities, one at a time. See section Graphic History on page 55 for details about graphical display.

DIR

Use the serial line and issue the **DIR** command to check the available files.

The device records five files (five observation periods) for each selected quantity. Thus, total amount of the files depends on the amount of the selected quantities being at minimum 5 and at maximum 15. See Table 10 on page 55 above.

Select, for example, two quantities (TDF and T). The last two columns illustrate software information that is not essential for the user.

Example:

```
>dir
0 Tdf latest 3 hours          99-12-31 21:35:48      135      025A
1 Tdf latest 1 day           99-12-30 21:58:18      135      040C
2 Tdf latest 10 days         99-12-20 18:58:18      135      0802
3 Tdf latest 2 months        99-10-25 12:58:18      135      080C
4 Tdf latest 1 year          98-11-22 00:58:18      135      1003
5 x latest 3 hours           99-12-31 21:35:48      135      025A
6 x latest 1 day             99-12-30 21:58:18      135      040C
7 x latest 10 days           99-12-20 18:58:18      135      0802
8 x latest 2 months          99-10-25 12:58:18      135      080C
9 x latest 1 year            98-11-22 00:58:18      135      1003
10 SSR latest 3 hours         99-12-31 21:35:48      135      025A
11 SSR latest 1 day           99-12-30 21:58:18      135      040C
12 SSR latest 10 days         99-12-20 18:58:18      135      0802
13 SSR latest 2 months        99-10-25 12:58:18      135      080C
14 SSR latest 1 year          98-11-22 00:58:18      135      1003
>
```

PLAY

Use the **PLAY** [x] command to output the selected file to the serial line. Before giving the command, set the correct date and time with **TIME** and **DATE** commands, if needed.

Syntax: **PLAY** [x]

where

x = 0 ... 14

Example:

```
>play 2
SSR latest 1 day          99-12-30 21:50:51          135          040C
Date      Time            trend    min      max
yy-mm-dd hh:mm:ss        %        %        %
99-12-30 21:50:51        15.32    15.21    15.44
99-12-30 22:02:51        15.39    15.34    15.45
99-12-30 22:14:51        15.48    15.34    15.76
99-12-30 22:26:51        15.49    15.42    15.57
99-12-30 22:38:51        15.43    15.30    15.64
99-12-30 22:50:51        15.50    15.39    15.60
99-12-30 23:02:51        15.67    15.52    15.79
99-12-30 23:14:51        15.75    15.56    16.01    Power outage
99-12-30 23:26:51        15.90    15.58    18.03
99-12-30 23:38:51        15.96    15.37    16.36
99-12-30 23:50:51        15.70    15.33    16.02
99-12-31 00:02:51        15.84    15.72    15.92
99-12-31 00:14:51        15.69    15.38    15.86
99-12-31 00:26:51        15.54    15.25    16.44
99-12-31 00:38:51        15.47    15.33    15.59
99-12-31 00:50:51        15.30    15.20    15.44
>
```

The <ESC> key can be used to interrupt the output listing.

The **PLAY -1** command can be used to output all files.

NOTE

Output of large amounts of recorded data can take a long time. If you are using the user port, select the highest serial baud supported to reduce the time required for output.

Deleting Recorded Files

Use the keypad/display to delete the recorded files. Note that the transmitter automatically overwrites the old data when the memory gets full, so manual deletion of the recorded files is not necessary.

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons.
2. Select **System** by pressing the ▶ arrow button.
3. Select **Clear graph memories** by pressing the **CLEAR** button. Press the **YES** button to confirm the selection.

CAUTION

This function clears all the data history from the memory, all graphs included.

DELETE/UNDELETE

Use the serial line to delete or undelete data files.

Use the **DELETE** command to delete all data files. Use the **UNDELETE** command to recover the deleted files.

NOTE

The **UNDELETE** command will only recover the part of the deleted data that has not been recorded over yet.

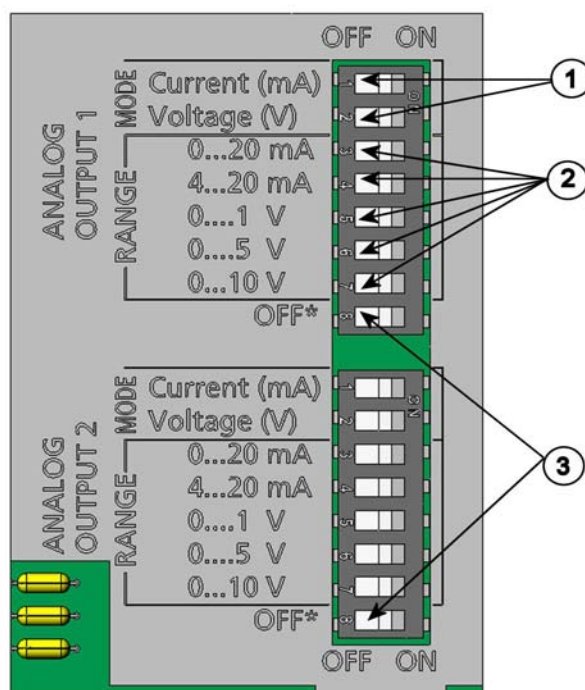
Analog Output Settings

The analog outputs are set in the factory according to the order form. In case you want to change the settings, follow these instructions.

Changing Output Mode and Range

Both output channels have their own dip switch module with 8 switches, see the position in Figure 2 on page 19 (dip switches for analog output settings).

1. Select the current/voltage output, switch ON either of the switches, 1 or 2.
2. Select the range, switch ON one of the switches from 3 to 7.



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Figure 45 Current/Voltage Switches of Output Modules

Numbers refer to Figure 45 above:

- 1 = Current/voltage selection output switches (from 1 to 2)
- 2 = Current/voltage range selection switches (from 3 to 7) in analog output 1 and 2.
- 3 = Switches for service use only. Keep in OFF position always.

NOTE

Only one of the switches, 1 or 2, must be ON at a time.

Only one of the switches, 3 to 7, must be ON at a time.

Example:

0 ... 5 V voltage output selected for channel 1 and 4 ... 20 mA selected for channel 2.

	OFF	ON	Selection
1	<div></div>	<div></div>	Voltage output selected
2	<div></div>	<div></div>	
3	<div></div>	<div></div>	
4	<div></div>	<div></div>	
5	<div></div>	<div></div>	
6	<div></div>	<div></div>	0 ... 5 V selected
7	<div></div>	<div></div>	
8	<div></div>	<div></div>	

1	<div></div>	<div></div>	Current output selected
2	<div></div>	<div></div>	
3	<div></div>	<div></div>	
4	<div></div>	<div></div>	4 ... 20 mA selected
5	<div></div>	<div></div>	
6	<div></div>	<div></div>	
7	<div></div>	<div></div>	
8	<div></div>	<div></div>	

NOTE

If you have customized the error output setting (**AERR**), check that the set error values are still valid after changing the output mode/range, see section Analog Output Fault Indication Setting on page 90.

Analog Output Quantities

NOTE

The relative humidity and temperature readings are not those of the process itself but the ones measured after the cooling process. Therefore, they should not be selected as output quantities. They are meant to be used in calibration or during installation.

Use the display/keypad to change and scale the analog output quantities.

1. Open the **MAIN MENU** by pressing any of the **▲ ▼ ◀ ▶** arrow buttons.
2. Select **Interfaces** by pressing the **▶** arrow button.
3. Select **Analog outputs** by pressing the **▶** arrow button.
4. Select **Output 1/2/3** by pressing the **▶** arrow button.
5. Select **Quantity** by pressing the **▲ ▼** arrow buttons. Confirm your selection by pressing **CHANGE**.
6. Select **the quantity** by using the arrow buttons. Press **SELECT** to confirm your selection.
7. Select **Scale, lower limit**, by pressing the **▲ ▼** arrow buttons. Press **SET** to confirm your selection. Press **OK** to confirm your setting.
8. Select the upper limit by pressing the **▲ ▼** arrow buttons. Use the arrow buttons to set the upper limit value. Press **SET** to confirm your selection. Press **OK** to confirm your setting.
9. Press **EXIT** to return to the basic display.

AMODE/ASEL

Use the serial line to select and scale the analog output quantities. Connect the transmitter to the PC. Open the terminal connection between your PC and the transmitter.

1. Check the analog outputs with the **AMODE** command.

Example:

```
>amode
Ch1 output      : 0 ... 1V
Ch2 output      : 0 ... 1V
>
```

2. Select and scale the quantities for the analog outputs with the command **ASEL** [xxx yyy zzz]. Note that the optional quantities can be selected only if they have been selected when ordering the device.

where

xxx = Quantity of channel 1
yyy = Quantity of channel 2
zzz = Quantity of the optional analog output channel 3

Enter always all the quantities for all outputs. For quantities and their abbreviations see Table 5 on page 16.

Use the command **ASEL** [xxx yyy] as shown in the example below when using a device with two analog outputs.

Example:

```
>asel
Ch1 Tdf    low   : -20.00 'C ?
Ch1 Tdf    high  : 100.00 'C ?
Ch2 x      low   :  0.00 g/kg ?
Ch2 x      high  : 500.00 g/kg ?
>
```

Analog Output Tests

Use the display/keypad for testing to test the operation of the analog by forcing the outputs to known values. Measure then the values with a current/voltage meter.

Use the display/keypad for testing.

1. Open the **MAIN MENU** by pressing any of the ▲▼◀▶ arrow buttons.
2. Select **System** by pressing the ► arrow button.
3. Select **Diagnostics** by pressing the ► arrow button.
4. Select **Analog output tests** by pressing the ► arrow button.
5. Select one of the testing options **Force 0 %/50%/100% of scale**. Press **TEST** to confirm your selection. All outputs are tested simultaneously. The actual output value depends on the selected range.
6. Press **OK** to stop testing. Press **EXIT** to return to the basic display.

ITEST

Use the serial line to test the operation of the analog outputs. Use the command **ITEST** [*aa.aaa bb.bbb*] to force the analog outputs to entered values. The set values remain valid until you issue the command **ITEST** without parameters or reset the transmitter.

Syntax: **ITEST** [*aa.aaa bb.bbb*]

where

aa.aaa = Current or voltage value to be set for channel 1 (mA or V)
bb.bbb = Current or voltage value to be set for channel 2 (mA or V)

Example:

```
>itest 20
Ch1 (Tdf )      :      *      20.000 mA   H'CCD3
Ch2 (x   )      :      *      20.000 mA   H'CCCB
>itest 20 5
Ch1 (Tdf )      :      *      20.000 mA   H'CCD3
Ch2 (x   )      :      *      5.000 mA    H'34BD
>
```

Analog Output Fault Indication Setting

Factory default state for analog outputs during error condition is 0 V/0mA. Please be careful when selecting the new error value. The error state of the transmitter should not cause unexpected problems in process monitoring.

Use the display/keypad to set the analog output fault indication.

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons.
2. Select **Interfaces** by pressing the ▶ arrow button.
3. Select **Analog Outputs** by pressing the ▶ arrow button.
4. Select **Output 1/2/3** by pressing the ▶ arrow button.
5. Select Fault indication. Press **SET** to confirm your selection. Enter the fault indication value by using the arrow buttons. Press **OK** to confirm your setting. This value is outputted if a transmitter error occurs.
6. Press **EXIT** to return to the basic display.

AERR

Use the serial line **AERR** command to change the error output.

AERR

Example:

```
>aerr
Ch1 error out   : 0.000V ? 5.0
Ch2 error out   : 0.000V ? 5.0
>
```

NOTE

The error output value must be within a valid range for the output type.

NOTE

The error output value is displayed only when there are minor electrical faults such as a humidity sensor damage. When there is a severe device malfunction, the error output value is not necessarily shown.

Relay Operation

Quantity for Relay Output

A relay monitors the quantity chosen for the relay output. Any of the quantities available can be chosen.

Relay Setpoints

When the measured value is in between the "above" and "below" values, the relay is passive. When choosing lower value as "above" value and higher value as "below" value, the relay is passive when the measured value is not between the setpoints.

You can also set only one setpoint.

Hysteresis

Hysteresis function is to prevent the relay switching back and forth when measured value is near to the setpoint values.

Relay is activated when the measured value passes the exact value of the setpoint. When returning and passing the setpoint again relay is released only until the value reaches the setpoint increased/decreased by the hysteresis value.

Hysteresis should be smaller than difference of the setpoints.

Example:

When the 'active above' value is 50 °C and the hysteresis value is 2 °C, relay activates when the relative humidity reaches 50 °C. As the humidity then decreases, relay releases at 48 °C.

```
>rsel tdf ts
Rel1 Tdf  above: 0.00 'C ? 50
Rel1 Tdf  below: 0.00 'C ? -
Rel1 Tdf  hyst : 0.00 'C ? 2
Rel1 Tdf  enabl: OFF ? on
Rel2 Ts   above: 0.00 'C ? 80
Rel2 Ts   below: 0.00 'C ? 60
Rel2 Ts   hyst : 0.00 'C ? 1
Rel2 Ts   enabl: OFF ? on
>
```

NOTE

If both setpoints are specified and "above" setpoint is lower than "below" setpoint, the hysteresis works in the opposite direction, that is, relay **is released** when the measured value passes the exact value of the setpoint.

Relay Indicating Transmitter Error Status

You can set a relay to follow the operation status of the device. By selecting **FAULT/ONLINE STATUS** for output quantity a relay changes state on the basis of the operation status as follows:

FAULT STATUS

Normal operation : relay active (C and NO outputs are closed)

Not measuring state : relay released (C and NC outputs are closed)
(error state or
power off)

ONLINE STATUS

Live measurement : relay active (C and NO outputs are closed)
(data available)

No live data : relay released (C and NC outputs are closed)
(for example, error,
AutoCal, purge or
adjustment mode)

Enabling/Disabling Relays

You can deactivate the relay outputs for example for service purposes of your system.

Indication Led Operation

Relay is activated: LED is lit

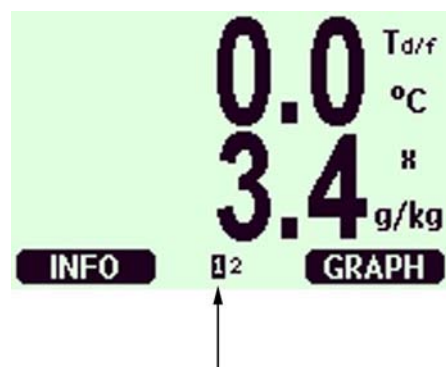
Relay is not activated: LED is not lit

Setting Relay Outputs

NOTE

When having only one relay module installed, its relays are called 'relay 1' and 'relay 2'.

When having two relay modules, the relays of the module connected to slot **MODULE 1 (communications)** are called 'relay 1' and 'relay 2' and relays connected to slot **MODULE 2** are called 'relay 3' and 'relay 4'



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Figure 46 Relay Availability

Arrow in Figure 46 above shows where enabled relays are listed on the display. Activation state shown in black. Disabled relays are not shown.

Use the display/keypad to set the relay outputs.

1. Open the **MAIN MENU** by pressing any of the **▲ ▼ ◀ ▶** arrow buttons.
2. Select **Interfaces**, confirm by pressing the **▶** arrow button.
3. Select **Relay outputs**, confirm by pressing the **▶** arrow button.
4. Select **Relay 1/2/3/4**, confirm by pressing the **▶** arrow button.
5. Select the **Quantity**, confirm by pressing **Change**. Select the Quantity by using the arrow buttons. Confirm your selection by pressing **Select**. (Press **Fault Status** when the relay follows the transmitter error.) Press **Change** to set the value.
6. Select **Act. above / Act. below**. Press **SET** to confirm your selection. If asked, select **MODIFY** if you want to set the setpoint by using the arrow buttons. Select **REMOVE** if you want to remove the setpoint.
7. Select Hysteresis Press **SET**. Set the hysteresis by using the arrow buttons. Press **OK**.
8. Select Relay enable, press **ON/OFF** to enable/disable the relay.

RSEL

Use the serial line to select the quantity, setpoints and hysteresis or enable/disable the relay outputs. Issue the **RSEL** command.

Syntax: **RSEL** *[q1 q2 q3 q4]*

where

q1 = quantity for the relay 1 or Fault/Online
 q2 = quantity for the relay 2 or Fault/Online
 q3 = quantity for the relay 3 or Fault/Online
 q4 = quantity for the relay 4 or Fault/Online

Factory setting: all relays disabled.

Use the quantity abbreviations presented above. See Table 5 on page 16.

Example of window limit switch: Selecting relay 1 to follow dewpoint measurement and relay 2 to follow sensor temperature measurement. Two relay setpoints are set for both relays.

```
>rsel tdf ts
Rel1 Tdf  above: 70.00 'C ? 50
Rel1 Tdf  below: - ? 30
Rel1 Tdf  hyst : 2.00 'C ? 2
Rel1 Tdf  enabl: ON ? on
Rel2 Ts   above: 140.00 'C ? 140
Rel2 Ts   below: - ? 80
Rel2 Ts   hyst : 2.00 'C ? 2
Rel2 Ts   enabl: ON ? on
>
```

Example of normal limit switch: Selecting relay 1 to follow sensor saturation rate and relay 2 to follow sensor temperature. One setpoint is chosen for all the outputs.

```
>rsel ssr ts
Rel1 SSR  above: 50.00 % ? 70
Rel1 SSR  below: - ? -
Rel1 SSR  hyst : 2.00 % ? 2
Rel1 SSR  enabl: ON ? on
Rel2 Ts   above: 80.00 'C ? 140
Rel2 Ts   below: 60.00 'C ? -
Rel2 Ts   hyst : 1.00 'C ? 2
Rel2 Ts   enabl: ON ? on
>
```

Example of using relay 1 as fault alarm: selecting relay 1 to follow the fault status and relay 2 to follow the temperature measurement.

```
>rsel fault ts
Rel1 FAUL above: -
Rel1 FAUL below: -
Rel1 FAUL hyst : -
Rel1 FAUL enabl: ON ? on
Rel2 Ts   above: 140.00 'C ? 140
Rel2 Ts   below: 80.00 'C ? 80
Rel2 Ts   hyst : 2.00 'C ? 2
Rel2 Ts   enabl: ON ? on
>
```

Testing Operation of Relays

Testing activates relays even if they are disabled.

Use the module push buttons to activate the relays. Press the **REL 1** or **REL 2** button to activate the corresponding relay.

Use the display/keypad to test the operation of relays.

1. Open the **MAIN MENU** by pressing any of the ▲▼◀▶ arrow buttons.
2. Select **System**, press the ► arrow button.
3. Select **Diagnostics**, press the ► arrow button.
4. Select **Relay tests**, press the ► arrow button.
5. Select **Invert relay 1 ...** , press **TEST**. Now the selected relay output is forced to opposite state. Press **OK** to return to normal operation.
6. Press **EXIT** to return to the basic display.

RTEST

Use the serial line command **RTEST** [ON/OFF ON/OFF] to test the operation of the relays.

Example: Testing all four relays.

```
>rtest on on on on
ON ON ON ON
>
>rtest off off off off
OFF OFF OFF OFF
```

Issue the command **RTEST** to stop testing.

RS-485 Module Operation

RS-485 interface enables communication between RS-485 network and DMT346 transmitter. The RS-485 interface is isolated and offers a maximum communications rate of 115 200 bits/s. (For maximum bus length of 1 km, use bit rate 19200 b/s or less.)

When selecting an RS-232-RS-485 converters for the network, avoid self powered converters as they don't necessarily support the needed power consumption.

Echo function shall be always disabled (OFF) when using the 2-wire connection. When using the 4-wire connection you can disable/enable the echo setting.

NOTE

User port on DMT346 main board cannot be used and connected when RS-485 module is connected. Service port is operating normally.

Networking Commands

Set the RS-422/485 interface by using the following commands. The other serial line commands are presented in section List of Serial Commands on page 64.

RS-485 configuration commands **SERI**; **ECHO**; **SMODE**; **INTV** and **ADDR** may be issued by using either the service port or RS-422/485 port. Also the optional display/keypad can be used.

SERI

Use the **SERI** [*b p d s*] command to input RS-485 bus settings.

Syntax: **SERI** [*b p d s*]

where

- b = baud rate (300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200)
- p = parity (n = none, e = even, o = odd)
- d = data bits (7 or 8)
- s = stop bits (1 or 2)

ECHO

Use the **ECHO** [x] command to enable/disable echo of characters received over the serial line.

Syntax: **ECHO** [x]

where

x = ON/OFF (default = OFF)

When using 2-wire connection, echo must be always disabled.

SMODE

Use the **SMODE** [xxxx] command to set the serial interface mode.

where

xxxx = STOP, RUN, POLL or SEND

- In STOP mode: measurements output only by command, all commands can be used
- In RUN mode: outputting automatically, only command S can be used to stop, see command **INTV** below.
- In POLL mode: measurements output only with command SEND. See command **ADDR** on page 99.
- In SEND mode: no commands are needed, a message is automatically outputted after power-up

When several transmitters are connected to the same line, each transmitter must be issued an own address in the initial configuration, and POLL mode must be used.

INTV

Use the **INTV** [n xxx] command to set the RUN mode output interval.

Syntax: **INTV** [n xxx]

where

n = 1 - 255
xxx = S, MIN or H

Sets the RUN mode output interval. The time interval is used only when the RUN mode is active.

Example:

The output interval is set to 10 minutes

```
>intv 10 min
Output intrv. :    10 min
>
```

Setting RUN output interval to zero enables the fastest possible output rate.

ADDR

Addresses are required only for POLL mode (see serial line command **SMODE** on page 98). Use the **ADDR** [*aa*] command to input the RS-485 transmitter address.

where

aa = address (0 ... 99) (default = 0)

Example:

The transmitter is issued the address 99

```
>addr
Address : 2 ? 99
>
```

OPEN [*nn*]

When all transmitters on the RS-485 bus are in POLL mode the **OPEN** [*nn*] command sets one transmitter temporarily to STOP mode so that other commands can be issued.

Syntax: **OPEN** [*nn*]

where

nn = address of the transmitter (0 ... 99)

CLOSE

The **CLOSE** command switches the transmitter back to the POLL mode.

Example:

```
>OPEN 2 (opens the line to transmitter 2, other  
transmitters stay in POLL mode)  
>CRH(for example, calibration performed)  
...  
>CLOSE (line closed)
```

SDELAY

With the **sdelay** command you can set delay (response time) for user port (RS-232 or RS-485), or view currently set delay value. Value corresponds to tens of milliseconds (eg. 5 = 0.050s minimum answer delay). The value can be set between 0...254.

Example:

```
>sdelay  
Serial delay : 0 ? 10  
>sdelay  
Serial delay : 10 ?  
>
```

Sensor Functions

AutoCal

To obtain the best possible accuracy in measurements taken in dry environments, DMT345 and DMT346 have a built-in AutoCal feature. During the AutoCal, the transmitter adjusts the dry-end reading to correspond to the calibrated values. This is a unique and patented method to avoid errors in accuracy when monitoring low dewpoints.

The AutoCal is carried out if the following criteria for the measurement environment are fulfilled:

- Relative humidity must be <10 %.
- Temperature must be $0 < T < 140$ °C.
- Humidity environment must be stable. The maximum change in the dewpoint can be 2 °C in 15 seconds.

NOTE

AutoCal cannot operate if the above conditions are not fulfilled.

If the adjustment in the AutoCal reaches a preset maximum value or if the AutoCal correction fails, for example, because of unstable conditions, a new AutoCal will take place later (if the automatic AutoCal is turned on).

Automatic AutoCal

As a default, the automatic AutoCal in DMT345 and DMT346 is turned on. In this mode, the calibration takes place automatically if the dewpoint or temperature changes significantly, typically more than 10 °C. However, if there are no changes in the conditions, the AutoCal will take place repeatedly after one hour from the last AutoCal.

Manual AutoCal

To ensure that AutoCal has taken place for obtaining the most accurate measurement in a very dry environment, you can perform Autocal manually before measuring as follows:

1. Open the **MAIN MENU** by pressing any of the ▲ ▼ ◀ ▶ arrow buttons.
2. Select **Measuring**, press the ▶ arrow button.
3. Select **Manual AutoCal**, press the ▶ arrow button.
4. Press **START** to start AutoCal. If the AutoCal conditions are not fulfilled, a note appears on the display informing that the calibration cannot be made.

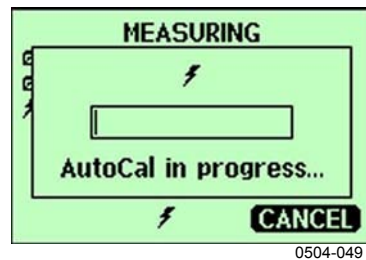


Figure 47 Following AutoCal on the Display

5. Press **EXIT** to return to the basic display.

You can also activate Manual AutoCal by pressing both **AUTOCAL** buttons on the transmitter motherboard. These are the same buttons as the pressure set buttons, but when pressed simultaneously, they will start the AutoCal procedure. See Figure 43 on page 74 for location of the **AUTOCAL**/pressure set buttons.

If the AutoCal conditions are not fulfilled, a note appears on the display informing that the calibration cannot be made.

Sensor Purge

Sensor Purge is available for DMT345 and DMT346. The Purge should be carried out to achieve the shortest response times and the best long-term stability.

Sensor Purge is an automatic procedure, in which the sensor is dried. Thus, the sensor will response very fast when installing the probe from an ambient to a dry gas. Sensor Purge also corrects the possible gain drift caused by some chemicals, thus ensuring together with AutoCal the best measurement accuracy and long-term stability.

As a default, the interval Purge and power-up Purge are turned on automatically in DMT345 and DMT346. It is recommended not to turn them off. The automatic sensor Purge can also be started manually. If enabled, power-up Purge will start always about 10 seconds after reset. If the power is continuously turned on in the transmitter, the automatic sensor Purge will be performed at an interval of 24 hours.

Manual Sensor Purge

The Purge should be performed always before calibration (see the calibration instructions) or when there is a reason to believe that a sensor has become exposed to an interfering chemical.

1. Open the **MAIN MENU** by pressing any of the ▲▼◀▶ arrow buttons.
2. Select **Measuring**, press the ► arrow button.
3. Select **Purge**, press the ► arrow button.
4. Select Manual Purge using the arrow buttons.

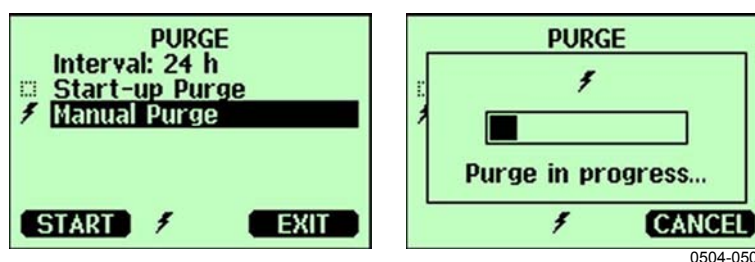


Figure 48 Performing Manual Purge

5. Press **START** to start manual Purge. Press **CANCEL** to interrupt the manual sensor Purge.
6. Press **EXIT** to return to the basic display.

Interval Purge

When DMT345 and DMT346 leave the factory the interval Purge takes place repeatedly with the time intervals set in the factory. The user can change the interval in which the purge takes place by using serial commands or with the optional display/keypad. This can be needed if the measuring environment contains high concentrations of interfering chemicals.

Power-Up Purge

Purge is to start within 10 seconds from the power-up of the device. This function can be disabled by using the serial line or the display/keypad.



Figure 49 Activating Start-up Purge

1. Press ON to activate Start-up Purge. Pressing OFF disables the function.
2. Press EXIT to return to the basic display.

PUR

With the PUR command you can enable or disable interval and power-up Purge and set the interval for interval purge. The default purge interval is 24 hours.

It is not recommended to change these settings.

Type **PUR** and press Enter to proceed.

Example:

```
>pur
Interval Purge : ON ?
Interval       : 1440 min ?
Power-up Purge : ON ?
Duration       : 60 s ?
Settling       : 240 s ?
Temperature    : 180 'C ?
Temp. diff.    : 0.5 'C ?
Trigger Purge  : OFF ?
RH trigger     : 20 %RH ?
>
```

NOTE

When Purge in power up is enabled, wait about 5 min after power up before taking measurements. The output channels are locked for the first operation minutes to the initial measured values.

PURGE

Use the command **PURGE** to start the manual Purge. Issue command **PURGE** to start Purge immediately.

Example:

```
>purge
Purge started, press any key to abort.
>
```

The prompt '>' appears when the heating period is over. However, the transmitter outputs are locked to values measured before purge until the settling time is over.

Sensor Warming

DMT345 and DMT346 contain a sensor warming function, that is, when humidity reaches a set limit (default: 80%RH), sensor warming operation is activated automatically. Sensor warming continues as long as the humidity is above that limit.

When the warming starts, the sensor operation indicator is displayed on the optional display and relays configured as "online status" (if any) will be released. Warming does not affect $T_{d/f}$, $T_{d/f atm}$, T_d , $T_{d atm}$, X , H_2O and P_w quantities, all others will be frozen.

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CHAPTER 5

CALIBRATION AND ADJUSTMENT

This chapter provides you with instructions on how to calibrate and adjust Vaisala DRYCAP[®] Dewpoint Transmitters DMT345 and DMT346.

Calibration

DMT345 and DMT346 are fully calibrated and adjusted as shipped from the factory. The typical calibration interval is one year. Calibration must always be done when there is reason to believe that the device is not within the accuracy specifications.

It is recommended that the device should be sent to a Vaisala Service Center for calibration and adjustment, see contact information under heading Vaisala Service Centers on page 125.

NOTE

If the process is not shut down for removing the transmitter for calibration, the hole for the probe in the cooling set must be plugged; otherwise, there is a risk of water condensing inside the cooling pipe (in overpressurized processes).

User Calibration and Adjustment

When adjusting DMT345 or DMT346, the reading of the transmitter is changed to correspond to the reference value. After the adjustment, the original calibration certificate shipped with the product is no longer valid.

The following adjustments are possible:

- Two-point relative humidity adjustment
- One-point dewpoint adjustment
- One-point temperature adjustment
- Two-point temperature adjustment
- Analog output adjustment

Opening and Closing Adjustment Mode

Open the transmitter cover. The buttons needed in the adjustment are on the left-hand side of the motherboard, see Figure 2 on page 19 above.

Press the **ADJ** button to enable the adjustment mode. The indicator led indicates the adjustment availability.

Table 27 Indicator Led Functions

Indicator Led Function	Description
LED off	adjustment locked
LED on	adjustment available
LED blinking evenly	measurement not stabilized
LED blinking with short pulses	performing Purge/AutoCal

Press the **ADJ** button again to disable the adjustment mode.

NOTE	Fixed pressure compensation of 1013.25 hPa is used when in adjustment mode. Adjustments should be performed at ambient pressures.
-------------	---

Adjustment Information

These data are shown on the device information. (see section Device Information on page 79). Use the display/keypad to feed the adjustment information.

1. If you are not in the adjustment menu, press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.
2. Press the ► arrow button to select **Adjustment info**.
3. Select **Date**, press **SET**. Enter the date by using the arrow buttons. Press **OK**.
4. Select **i**, press **SET**. Enter information text including 17 characters at maximum by using the arrow buttons. Press **OK**.
5. Press **EXIT** to return to the basic display.

CTEXT and CDATE

Use the serial line command **CTEXT** to enter text in to the adjustment information field. First press the adjustment button on the motherboard inside the transmitter.

Example:

```
>ctext
Adjust. info    : (not set) ? -60°C
>
```

Use the command **CDATE** to input date to the adjustment information field. Set the adjustment date in format YYYY-MM-DD.

Example:

```
>cdate
Adjust. date    : (not set) ? 2004-05-21
>
```

Press the adjustment button on the motherboard inside the transmitter to disable the adjustment function.

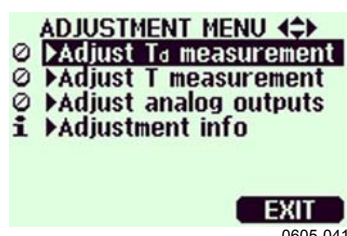
Two-Point Relative Humidity Adjustment

Using Display/Keypad

NOTE

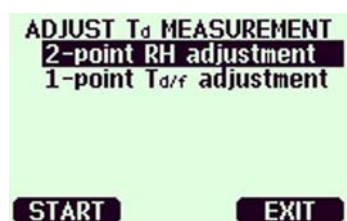
Reference humidities must be ~ 0 %RH and 30 ... 75 %RH. A suitable product for the two point RH calibration is for example the Vaisala Humidity Calibrator HMK15.

1. Press the **ADJ** button (see Figure 2 on page 19) to open the **ADJUSTMENT MENU**):
2. Select **Adjust T_d measurement**, press **↵** button.



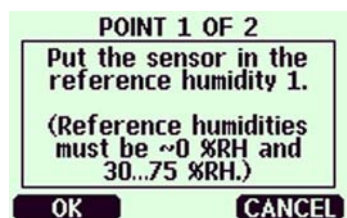
0605-041

3. Select **2-point RH adjustment**, press **START**. At this point, the device carries out the chemical purge.



0605-042

4. Remove the filter from the probe and insert the probe head in the dry end reference condition (~ 0 %RH). Press **OK**.



0605-047

5. Wait at least 30 minutes for the sensor to stabilize. Follow the stabilization from the **GRAPH** display. Press **EXIT** to return to the previous display.
6. Press **READY** when stabilized. Enter the reference value by using the arrow keys.



Now proceed to the adjustment at the wet end reference condition (30 ... 75 %RH) and carry out the procedure as described in the previous items.

7. Answer **YES** to confirm the adjustment. Press **OK** to return to the adjustment menu.
8. Before closing the adjustment mode, feed the adjustment information into the device, see section Adjustment Information on page 109. Press **EXIT** to close the adjustment mode and return to the basic display.

Using Serial Line

NOTE

Reference humidities must be ~0 %RH and 30 ... 75 %RH. A suitable product for the two point RH calibration is for example the Vaisala Humidity Calibrator HMK15.

1. Connect the DMT345/346 to a PC. See section Serial Line Communication on page 60. Open a terminal program.
2. Carry out the chemical purge.
3. Press the **ADJ** button.
4. Remove the filter from the probe and insert the probe head in the dry end reference conditions (~0 %RH).
5. Issue the **FCRH** command and press Enter.

FCRH

6. Wait at least 30 minutes for the sensor to stabilize.
7. Press Enter a few times to check if the reading is stabilized.
8. When the reading is stabilized, give the reference humidity after the question mark and press Enter.

```
>fcrh
```

```
RH : 11.25 Ref1 ?  
RH : 11.25 Ref1 ?  
RH : 11.25 Ref1 ?  
RH : 11.24 Ref1 ?  
RH : 11.24 Ref1 ? 11.3  
Press any key when ready ...
```

9. Now the device is waiting for the wet end reference. Insert the probe in the wet end reference condition (30 ... 75 %RH). Press any key when ready.
10. Let the probe stabilize for about 30 minutes. You can follow the stabilization by pressing Enter.
11. When stabilized, type the high end reference value after the question mark and press Enter.

```
>fcrh
```

```
RH : 11.25 Ref1 ? c  
RH : 11.24 Ref1 ? c  
RH : 11.24 Ref1 ? 11.3  
Press any key when ready ...
```

```
RH : 75.45 Ref2 ? c  
RH : 75.57 Ref2 ? c  
RH : 75.55 Ref2 ? c  
RH : 75.59 Ref2 ? 75.5  
OK  
>
```

12. The OK indicates that the adjustment has succeeded and the new calibration coefficients are calculated and stored. Enter the adjustment information (date and text) to the memory of the transmitter, see section Adjustment Information on page 109.
13. Press the **ADJ** button on the motherboard to close the adjustment mode.
14. Take the probe out of the reference conditions and replace the filter.

One-Point Dewpoint Adjustment

One-Point Dewpoint Adjustment Using Display/Keypad

NOTE

This is a highly critical adjustment, to be performed only in laboratory conditions.

Preferably use the display/keypad interface to perform one-point dewpoint $T_{d/f}$ adjustment. Before proceeding with the $T_{d/f}$ adjustment you must perform the RH adjustment. For DMT345/346, the reference dewpoint must be below $-25\text{ }^{\circ}\text{C}$ ($-13\text{ }^{\circ}\text{F}$) and temperature must be below $40\text{ }^{\circ}\text{C}$ ($104\text{ }^{\circ}\text{F}$).

NOTE

This adjustment is valid only if the measurement or process is in the lower end of the measurement range (in very dry). See Specifications on page 127.

When adjusting the dewpoint, refer to the following instructions:

1. Press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.
2. Press the ► arrow button to select **Adjust T_d measurement**.
3. Select by pressing **1-point T_d adjustment**. Press **START** to start adjusting.
4. Leave the sensor to stabilize for at least one (1) hour. Follow the instructions on the display.

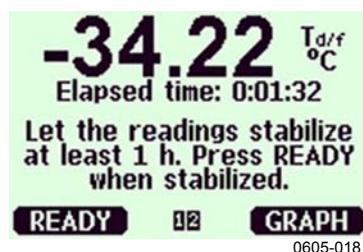


Figure 50 Following Stabilization

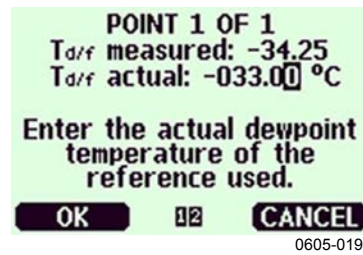


Figure 51 Proceeding with $T_{d/f}$ Adjustment

5. Enter the actual reference frostpoint temperature.
6. The transmitter performs $T_{d/f}$ adjustment. This may take up to six (6) minutes.

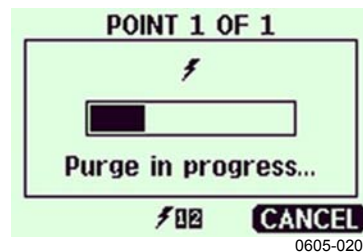


Figure 52 Completing $T_{d/f}$ Adjustment

7. The adjustment is now completed.

NOTE

Several AutoCals can be necessary after this adjustment has been performed until the transmitter reaches full accuracy.

One-point Dewpoint Adjustment Using Serial Line

1. Let the sensor stabilize for at least one (1) hour.
2. Press the **ADJ** button on the motherboard to enable adjustments.
3. Use the **A01** command to perform the adjustment.

Syntax: **A01**

Example:

```
>a01  
Tf :    -34.25 'C  Ref ? -33  
Wait for Purge data...OK  
>
```

4. Press the **ADJ** button on the motherboard inside the transmitter to disable adjustments.

NOTE

Several AutoCals can be necessary after this adjustment has been performed until the transmitter reaches full accuracy.

Adjusting Temperature

NOTE

Temperature adjustment in process conditions is possible only with DMT345. Temperature adjustment of DMT346 cannot be performed in process conditions as the DMT346 measures a cooled temperature whereas the reference instrument measures the actual process temperature.

Adjusting Temperature Using Display/Keypad

Use preferably the display/keypad to adjust the temperature.

1. Press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.
2. Press the **►** arrow button to select **Adjust T measurement**.
3. Select by pressing **1-point or 2-point adjustment**. Press **START** to start adjusting.
4. Remove the filter from the probe and insert the probe head into a reference temperature.
5. Wait at least 30 minutes for the sensor to stabilize. Follow the stabilization from the **GRAPH** display.
6. Press **READY** when stabilized. Enter the reference temperature by using the arrow buttons.

When carrying out the two-point adjustment proceed to the next adjustment point and carry out the procedure as described in the previous items. Note that the difference between the two temperature references must be at least 30 °C.

7. Press **OK**. Press **YES** to confirm the adjustment.
8. Press **OK** to return to the adjustment menu
9. Press **EXIT** to return to the basic display.

Adjusting Temperature Using Serial Line

CT

Use the serial line command **CT** to adjust the temperature.

1. Press the **ADJ** button on the motherboard to open the adjustment mode.
2. Remove the probe filter and insert the probe head into the reference temperature.
3. Type **CT** and press Enter. Type **C** and press Enter to check if the reading is stabilized.
4. Let the reading stabilize, enter the reference temperature after the question mark and press Enter three times.

When having another reference temperature (two-point adjustment) press Enter twice and insert the probe to the second reference. When the reading is stabilized, enter the second reference temperature after the question mark and press Enter. Please, note that the difference between the two temperature references must be at least 30 °C.

Example (1-point adjustment):

```
>ct
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? 16.0
Press any key when ready ...
T   :    16.06  Ref2 ?
OK
>
```

OK indicates that the calibration has succeeded.

5. Press the **ADJ** button on the motherboard to close the adjustment mode.
6. Take the probe out of the reference conditions and replace the filter.

Adjusting Analog Outputs

In the analog output calibration the analog output is forced to the following values:

current output = 2 mA and 18 mA

voltage output = 10 % and 90 % of the range

Connect DMT346 to a calibrated current/voltage meter in order to measure either current or voltage depending on the selected output type. Use the display/keypad or the serial line to do this.

Adjusting Analog Outputs Using Display/Keypad

1. Press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.
2. Press the **►** arrow button to select **Adjust analog outputs**.
3. Select the output to be adjusted **Adjust analog output 1/2**, press **START**.
4. Measure the first analog output value with a multimeter. Enter the measured value by using the arrow buttons. Press **OK**.
5. Measure the second analog output value with a multimeter. Enter the measured value by using the arrow buttons. Press **OK**.
6. Press **OK** to return to the adjustment menu.
7. Press **EXIT** to close the adjustment and to return to the basic display.

Adjusting Analog Outputs Using Serial Line

ACAL

Use the serial line to perform the analog output adjustment. Use the **ACAL** command and enter the multimeter reading.

Example (current outputs):

```
>ACAL
Ch1  I1  (mA) ?    2.046
Ch1  I2  (mA) ?   18.087
Ch2  I1  (mA) ?    2.036
Ch2  I2  (mA) ?   18.071
>
```

Press the adjustment button on the motherboard inside the transmitter again to disable the adjustment function.

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CHAPTER 6

MAINTENANCE

This chapter provides information that is needed in basic maintenance of the product. Possible error states and situations, their probable causes and remedies are described in this chapter. This chapter also contains contact information for Vaisala Technical Support and Vaisala Service Centers.

Periodic Maintenance

Cleaning

Clean the transmitter enclosure with a soft, lint-free cloth moistened with mild detergent.

Changing Cooling Set Filter

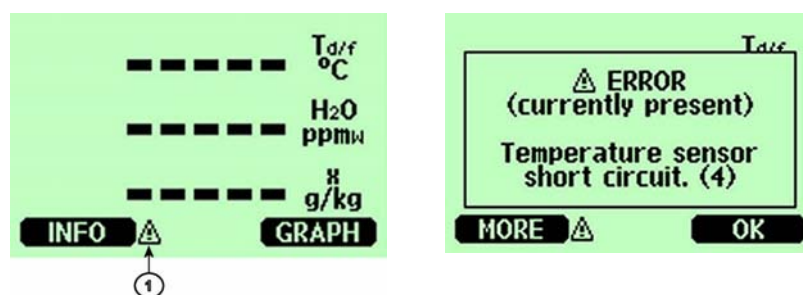
1. Unscrew the filter from the cooling set.
2. Screw a new filter on the probe head. When using the stainless steel filter, take care to tighten the filter properly (recommended force 130 Ncm).

New filters can be ordered from Vaisala, see Available Options and Accessories Table 42 on page 134.

Error States

In error state the quantity is not measured and the output is shown as follows:

- analog channel outputs 0 mA or 0 V (you can use the serial line command **AERR** or display/keypad to change this fault indication value, see section Analog Output Fault Indication Setting on page 90)
- the serial port outputs stars (***)
- the cover LED is blinking
- optional display: error indicator is lit.



0506-055

Figure 53 Error Indicator and Error Message

Number refers to Figure 53 above:

1 = Error Indicator

- The error indicator disappears when the error state is over and you have checked the error message. Press the **INFO** button to display the error message.

Table 28 Error Messages

Error Message	Action
Humidity sensor measurement malfunction.	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt, water, ice or other contaminants.
Humidity sensor short circuit	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt, water, ice or other contaminants.
Humidity sensor open circuit	Check the integrity of the humidity probe and the probe cable.
Temperature sensor open circuit.	Check the integrity of the humidity probe and the probe cable.
Temperature sensor short circuit.	Check the integrity of the humidity

Error Message	Action
	probe and the probe cable. Clean the probe from dirt water, ice or other contaminants.
Temperature measurement malfunction	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt water, ice or other contaminants.
Temperature sensor current leak.	Check the integrity of the humidity probe and the probe cables. Clean the probes from dirt, water, ice or other contaminants.
Internal ADC read error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal EEPROM read error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal EEPROM write error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Add-on module 1 (or 2) connection failure	Turn off the power and check the module connection. Turn on the power.
Device internal temperature out of range	Ensure that the operating temperature is within the valid range.
Operating voltage out of range	Ensure that the operating voltage is within the valid range.
Internal analog voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal system voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal ADC reference voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal analog output reference voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Configuration switches for analog output 1/2/3 set incorrectly	Check and re-set the switches, see page 51.
EEPROM failure on add-on module 1 (or 2)	Disconnect the power and check the analog output module connection.
Communication module installed in incorrect add-on module slot	Disconnect the power and change the communication module to another module slot.
Unknown/incompatible module installed in add-on module slot 1(or2)	Ensure that the module is compatible with the DMT345/346.

You can also check the error message via the serial interface by using the command **ERRS**. In case of constant error, please contact the Vaisala Service Centers (contact information on page 125).

Technical Support

For technical questions, contact the Vaisala Technical Support:

E-mail helpdesk@vaisala.com

Fax +358 9 8949 2790

Return Instructions

If the product needs repair, please follow the instructions below to enable us to serve you better.

1. Read the warranty information.
2. Please include with the transmitter:
 - serial number of the unit
 - date and place of purchase or last calibration
 - description of the fault
 - circumstances over which the fault occurs/occurred
 - name and contact information of a technically competent person who can provide further information on the problem
3. Include a detailed return address with your preferred shipping method.
4. Pack the faulty product using an ESD protection bag of good quality with proper cushioning material in a strong box of adequate size.
5. Contact the Vaisala Service Center nearest to you and send the box to the addresses on page 125:

Vaisala Service Centers

Vaisala Service Centers perform calibrations and adjustments as well as repair and spare part services, see contact information below.

Vaisala Service Centers offer also extended services, for example accredited calibrations, maintenance contracts and calibration reminder program. Do not hesitate to contact them to get further information.

NORTH AMERICAN SERVICE CENTER

Vaisala Inc., 10-D Gill Street, Woburn, MA 01801-1068, USA.

Phone: +1 781 933 4500, Fax: +1 781 933 8029

E-mail: us-customersupport@vaisala.com

EUROPEAN SERVICE CENTER

Vaisala Instruments Service, Vanha Nurmijärventie 21 FIN-01670 Vantaa, FINLAND.

Phone: +358 9 8949 2658, Fax: +358 9 8949 2295

E-mail: instruments.service@vaisala.com

TOKYO SERVICE CENTER

Vaisala KK, 42 Kagurazaka 6-Chome, Shinjuku-Ku, Tokyo 162-0825, JAPAN.

Phone: +81 3 3266 9617, Fax: +81 3 3266 9655

E-mail: aftersales.asia@vaisala.com

BEIJING SERVICE CENTER

Vaisala China Ltd., Floor 2 EAS Building, No. 21 Xiao Yun Road, Dongsanhuan Beilu, Chaoyang District, Beijing, P.R. CHINA 100027.

Phone: +86 10 8526 1199, Fax: +86 10 8526 1155

E-mail: china.service@vaisala.com

www.vaisala.com

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CHAPTER 7

TECHNICAL DATA

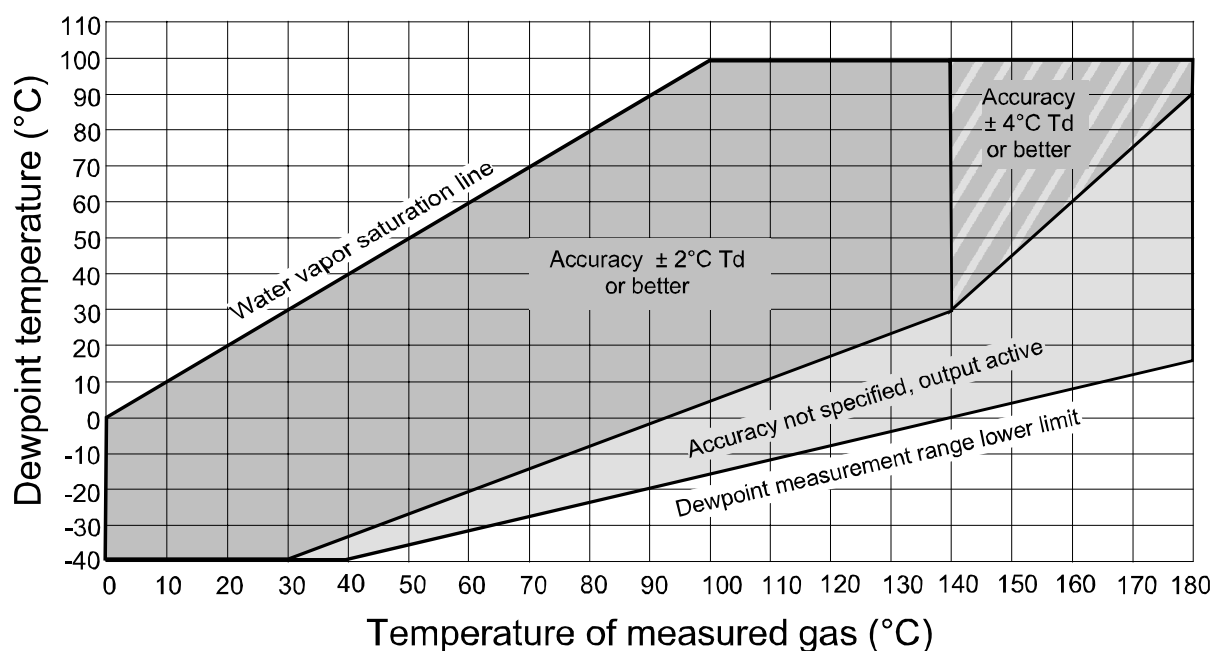
This chapter provides the technical data of the product.

Specifications

Performance

Table 29 Dewpoint Specifications DMT345

Property	Description / Value
Sensor	Vaisala DRYCAP®180S
Measurement range	-40 ... +100 °C (-40 ... +212 °F) T _d
Accuracy	±2 °C (±3.6 °F) T _d
	See accuracy graph in Figure 54 on page 128
Response time 63% [90%] flow rate 1l/min and 1 bar pressure	
from dry to wet	5s [10 s]
from wet to dry including auto-calibration	45s [5 min]



0605-043

Figure 54 Dewpoint Measurement Accuracy Graph for Vaisala DRYCAP® Dewpoint Transmitter DMT345

Table 30 Temperature Specifications DMT345

Property	Description / Value
Measurement range with sensor warming	0 ... +180 °C (+32 ... +356 °F) upper range limited by humidity (at 80% RH warming is switched on and T reading not actual process temperature)
Accuracy	±0.4 °C at 100 °C
Temperature sensor	Pt 100 IEC 751 1/3 class B

Table 31 Relative Humidity Specifications DMT345

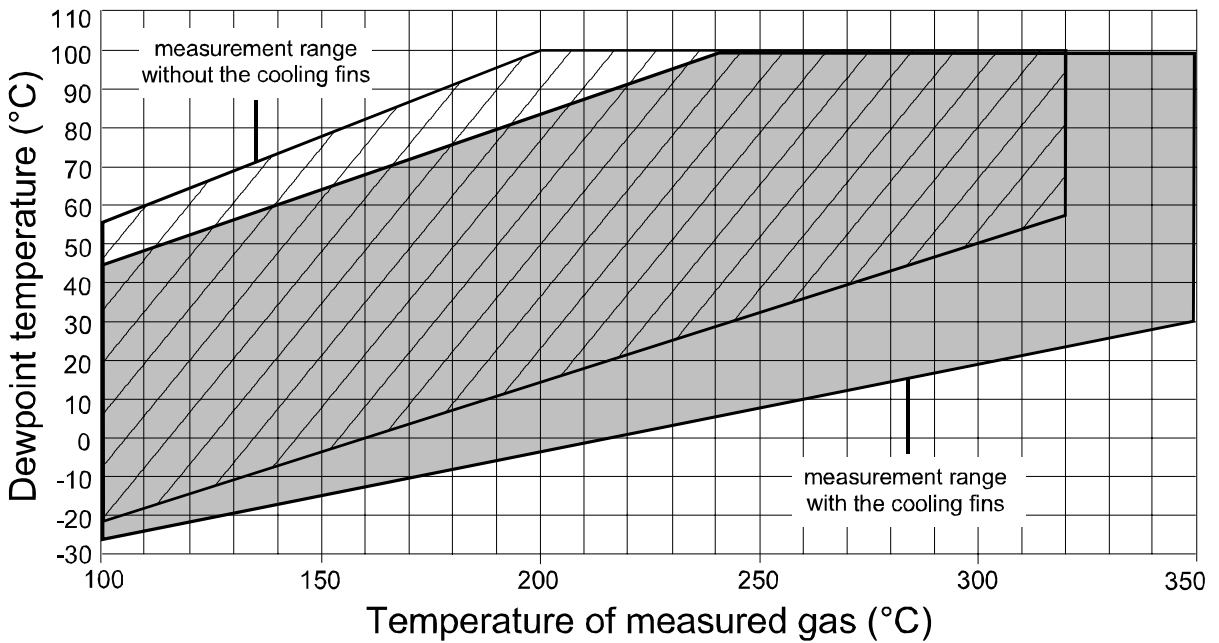
Property	Description / Value
Measurement range with sensor warming	0 ... 100 %RH 0 ... 80 %RH
Accuracy below 10% RH above 10% RH	±10 % of reading ±1.5 %RH + 1.5 % of reading

Table 32 Mixing Ratio Specifications DMT345

Property	Description / Value
Measurement range (typical)	0...1000 g/kg (0..7000 gr/lbs)
Accuracy	±12 % of reading

Table 33 Dewpoint Specifications DMT346

Property	Description / Value
Sensor	Vaisala DRYCAP®180S
Measurement range	-25 ... +100 °C (-13 ... +212 °F) T _d
Accuracy	±2 °C (±3.6 °F) T _d See the accuracy graph in Figure 55 below
Response time 63% [90%] flow rate 1l/min and 1 bar pressure from dry to wet	5s [10 s]
from wet to dry including auto-calibration	45s [5 min]



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Figure 55 Dewpoint Measurement Accuracy Graph for Vaisala DRYCAP® Dewpoint Transmitter DMT346

Table 34 Mixing Ratio Specifications DMT346

Property	Description / Value
Measurement range (typical)	0 ... 1000 g/kg (0 ... 7000 gr/lbs)
Accuracy	±12 % of reading

Table 35 Operating Environment Specifications (Both Models)

Property	Description / Value
Mechanical durability Probe heads for transmitter body with display	Up to +180 °C (+356 °F) for DMT345 Up to +350 °C (+662 °F) for DMT346 -40 ... +60 °C (-40 ... +140 °F) 0 ... +60 °C (32 ... +140 °F)
Storage temperature range	-55 ... +80 °C (-67...+176 °F)
Pressure range for probes	Slight pressure difference (~ 200 mbar)
Measured gases	Noncorrosive gases

Complies with EMC standard EN61326-1:1997 + Am1:1998 +
Am2:2001 Industrial Environment

Table 36 Inputs and Outputs Specifications (Both Models)

Property	Description / Value
Operating voltage with optional power supply module	10 ... 35 VDC, 24 VAC 100 ... 240 VAC 50/60 Hz
Default start-up time initial reading after power-up full operation after sensor Purge and AutoCal	3 s Approximately 6 min
Power consumption @ 20 °C (U_{in} 24 VDC) U_{out} 2 × 0 ... 1V / 0 ... 5V / 0 ... 10V I_{out} 2 × 0 ... 20 mA RS-232 Display and backlight During sensor purge and warming	Max 25 mA Max 60 mA Max 25 mA + 20 mA + 110 mA max
Analog outputs (2 standard, 3rd optional) Current output Voltage output	0 ... 20 mA, 4 ... 20 mA 0 ... 1 V, 0 ... 5 V, 0 ... 10 V
Accuracy of analog outputs at 20 °C	± 0.05 % full scale
Temperature dependence of the analog outputs	± 0.005 %/°C full scale
External loads Current outputs 0 ... 1V output 0 ... 5V and 0 ... 10V outputs	$R_L < 500 \Omega$ $R_L > 2 \text{ k } \Omega$ $R_L > 10 \text{ k } \Omega$
Max wire size	0.5 mm ² (AWG 20) stranded wires recommended
Digital outputs	RS-232, RS-485 (optional)
Relay outputs (optional)	0.5 A, 250 VAC, SPDT
Display (optional)	LCD with backlight, graphic trend display
Menu languages	English, French, Spanish, German, Japanese, Russian, Swedish, Finnish

Table 37 Mechanics Specifications (Both Models)

Property	Description / Value
Cable bushing	M20×1.5, for cable diameter 8 ... 11 mm / 0.31 ... 0.43"
Conduit fitting	1/2" NPT
User cable connector (optional) Option 1 Option 2	M12 series 8-pin (male) With plug (female) with 5 m / 16.4 ft black cable
Probe cable diameter	5.5 mm
Probe cable lengths	2 m, 5 m or 10 m
Housing material	G-AISI 10 Mg (DIN 1725)
Housing classification	IP 65 (NEMA 4X)
Housing weight	1.2 kg

Options and Accessories

Table 38 Options and Accessories

Description	Order code
Relay module	RELAY-1
Isolated RS485 Module	RS485-1
Power Supply Module	POWER-1
Galvanic Isolation Module	DCDC-1

Technical Specifications of Optional Modules

Table 39 Power Supply Module Technical Specifications

Description	Specification
Operating voltage	100 ... 240 VAC 50/60 Hz
Connections	screw terminals for 0.5 ... 2.5 mm ² wire (AWG 20 ... 14)
Bushing	for 8 ... 11 mm diameter cable
Operating temperature	-40 ... +60 °C (-40 ... +140 °F)
Storage temperature	-40 ... +70 °C (-40 ... +158 °F)

Table 40 Relay Module Technical Specifications

Description	Specification
Operating temperature range	-40 ... +60 °C (-40 ... +140 °F)
Operating pressure range	500 ... 1300 mmHg
Power consumption @24 V	max 30 mA
Contacts SPDT (change over), for example, Contact arrangement Form C I_{max} I_{max}	0.5 A 250 VAC 0.5 A 30 VDC
Safety standard for the relay component	IEC60950 UL1950
Storage temperature range	-55 ... +80 °C (-67 ... +176 °F)
3-pole screw terminal / relay	
Max wire size	2.5 mm ² (AWG14)

Table 41 RS-485 Module Technical Specifications

Description	Specification
Operating temperature range	-40 ... +60 °C (-40 ... +140 °F)
Operating modes	2-wire (1-pair) half duplex 4-wire (2-pair) full duplex
Operating speed max	115.2 kbaud
Bus isolation	300VDC
Power consumption @ 24 V	max 50 mA
External loads standard loads	32 $R_L > 10k\Omega$
Storage temperature range	-55 ... +80 °C (-67 ... +176 °F)
Max wire size	1.5 mm ² (AWG16)

Dimensions in mm (inches)

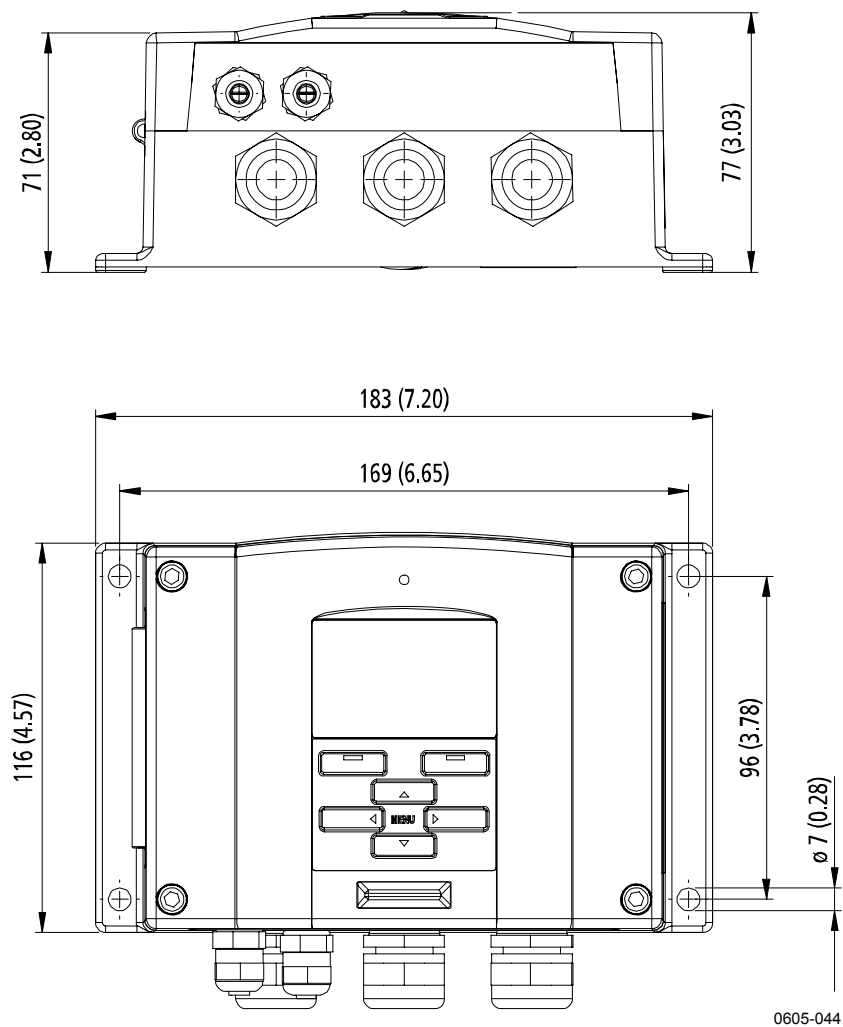


Figure 56 DMT345/346 Transmitter Body Dimensions

Spare Parts

Table 42 Available Spare Parts

Item	Order Code
MODULES	
Relay module	RELAY-1
Analog Output Module	AOUT-1
Isolated RS485 Module	RS485-1
Power Supply Module	POWER-1
Galvanic Isolation Module	DCDC-1
FILTERS	
for DMT345	
Sintered Filter AISI 316L	HM47280SP
for DMP246CS	
Sintered Filter AISI316L D=20mm	HM46780
TRANSMITTER MOUNTING ACCESSORIES	
Wall Mounting Kit	214829
Installation Kit for Pole or Pipeline	215108
Rain Shield with Installation Kit	215109
DIN Rail Clips with Installation Plate	215094
Panel Mounting frame	216038
PROBE MOUNTING ACCESSORIES	
DMT345	
Mounting Flange for D13.5mm Probe	210696
DMT346	
Cooling Set with Installation Flange	DMP246CS
Plug D13.5mm with Wire Rope	217738
Installation Flange for Cooling Set	217490
CONNECTION CABLES	
Serial Interface Cable	19446ZZ
MI70 Connection Cable with RJ45 Connector	211339
OUTPUT CABLES for 8-pin connector	
Connection Cable 5m 8-pin M12 Female, Black	212142
Connector 8-pin M12 with Screw Terminals	212416
Male Connector 8-pin M12 with Cable and Adapter	214806SP
CABLE BUSHINGS	
Cable Gland M20x1.5 for 8 ... 11 mm Cable	214728SP
Cable Gland M20x1.5 for 11 ... 14 mm Cable	214729
Conduit Fitting M20x1.5 for NPT1/2 Conduit	214780SP
Dummy Plug M20x1.5	214672SP
WINDOWS SOFTWARE	
Software Interface Kit	215005
OTHER	
Calibration Adapter for HMK15 (to fit the DMT345 probe)	211302SP

APPENDIX A

EXAMPLE INSTALLATION OF DMT346

This Appendix illustrates an example installation of DMT346 transmitter into a process.



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Figure 57 **Cooling Set Installation**

1. Make a round $89.5 + 0.5$ mm hole on the process wall.
2. Weld the tube of the mounting flange tightly on the inner metal plate of the process wall. If the process wall is more than 125 mm thick, a lengthening piece (max. 50 mm) can be welded on the mounting tube (for walls thicker than 175 mm, see Figure 23 on page 35).
3. The cooling set is mounted in a vertical position. Tighten the screws properly in order to ensure a thermal contact.
4. Unscrew the locking screws on the cooling bar so that you can push the sensor head into the bar.

NOTE

Push the sensor head deep enough: make sure that the marking hole meets the end of the bar.

5. Lock the sensor head in place by tightening the locking screws on the bar.

Probe and Cooling Set Mounting with Process Shut Down

- Complete the entire mounting process as instructed on page 33.

Probe and Cooling Set Mounting with Process Running

- First mount the cooling element (and fins) to warm it up; tightly plug the hole for the probe in the cooling element for the duration of the warmup period.
- After a few hours, complete the installation by installing the probe.

This procedure should lessen the amount of condensation that builds up in the hole.

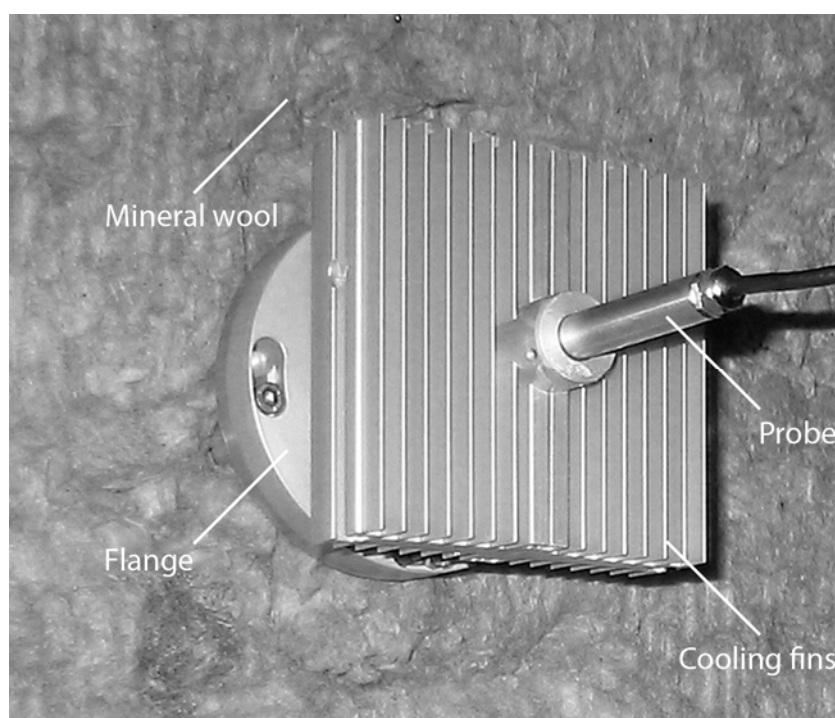


Figure 58 Insulation with Mineral Wool

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APPENDIX B

CALCULATION FORMULAS

This Appendix contains the formulas used for the calculated output quantities.

The DMT346 series transmitters measure relative humidity and temperature. From these values dewpoint, mixing ratio, absolute humidity and enthalpy in normal pressure are calculated using the following equations:

Dewpoint:

$$T_d = \frac{T_n}{\frac{m}{\log \frac{P_w}{A}} - 1} \quad (1)$$

The parameters A , m , and T_n depend on temperature according to the following table:

t	A	m	T _n
<0 °C ¹⁾	6.1134	9.7911	273.47
0 ... 50 °C	6.1078	7.5000	237.3
50 ... 100 °C	5.9987	7.3313	229.1
100 ... 150 °C	5.8493	7.2756	225.0
150 ... 180 °C	6.2301	7.3033	230.0

1) Used for frostpoint calculation if the dewpoint is negative

Mixing ratio:

$$x = 621.99 \cdot \frac{P_w}{p - P_w} \quad (2)$$

Absolute humidity:

$$a = 216.68 \cdot \frac{P_w}{T} \quad (3)$$

Enthalpy:

$$h = (T - 273.15) \cdot (1.01 + 0.00189 \cdot x) + 2.5 \cdot x \quad (4)$$

The water vapor saturation pressure P_{ws} is calculated by using two equations (5 and 6):

$$\Theta = T - \sum_{i=0}^3 C_i T^i \quad (5)$$

where:

$$\begin{aligned} T &= \text{temperature in K} \\ C_i &= \text{coefficients} \\ C_0 &= 0.4931358 \\ C_1 &= -0.46094296 \times 10^{-2} \\ C_2 &= 0.13746454 \times 10^{-4} \\ C_3 &= -0.12743214 \times 10^{-7} \end{aligned}$$

$$\ln P_{ws} = \sum_{i=-1}^3 b_i \Theta^i + b_4 \ln \Theta \quad (6)$$

where:

$$\begin{aligned} b_i &= \text{coefficients} \\ b_{-1} &= -0.58002206 \times 10^4 \\ b_0 &= 0.13914993 \times 10^1 \\ b_1 &= -0.48640239 \times 10^{-1} \\ b_2 &= 0.41764768 \times 10^{-4} \\ b_3 &= -0.14452093 \times 10^{-7} \\ b_4 &= 6.5459673 \end{aligned}$$

The water vapor pressure is calculated using:

$$P_w = RH \cdot \frac{P_{ws}}{100} \quad (7)$$

Parts per million by volume is calculated using:

$$ppm_v = 10^6 \cdot \frac{P_w}{(p - P_w)} \quad (8)$$

Symbols:

$$\begin{aligned} T_d &= \text{dewpoint temperature (}^\circ\text{C)} \\ P_w &= \text{water vapour pressure (hPa)} \\ P_{ws} &= \text{water vapour saturation pressure (hPa)} \\ RH &= \text{relative humidity (\%)} \\ x &= \text{mixing ratio (g/kg)} \\ p &= \text{atmospheric pressure (hPa)} \\ a &= \text{absolute humidity (g/m}^3\text{)} \\ T &= \text{temperature (K)} \\ h &= \text{enthalpy (kJ/kg)} \end{aligned}$$



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